DOCUMENT RESUME

ED 064 255 24 SP 005 800

AUTHOR Kubicek, Stephanie J.
TITLE An Investigation into Factors which Reinforce or Deter Creativity in Children. Final Report.
INSTITUTION Houston Univ., Tex.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Bureau of Research.
BUREAU NO BR-9-G-043
PUB DATE Jun 72
GRANT OEG-7-9-530043-0140(010)
NOTE 92p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Creative Activities; *Creative Development; *Creative Expression; *Creative Thinking; Effective Teaching; Interaction; Self Expression; Verbal Communication

ABSTRACT

This study designed an instrument which would illuminate that atmosphere which is most favorable to the creative process. Analysis of classroom verbal interaction was executed from tape recordings of 44 science sessions, representing 11 fifth grade science classes from five widely separated and diversified schools in the Houston area. A 42-item verbal interaction analysis category scale oriented toward creativity was implemented. Creative activities were identified according to the following criteria: 1) the expression by the student, of an idea which the teacher did not present; 2) expressed preoccupation with an idea or preoccupation with an idea or problem; 3) a statement or contribution which clarifies or summarizes the ideas of the teacher or fellow student; 4) the expressed desire to explore a problem or project beyond current knowledge or classroom material; 5) the expression of an idea which relates classroom discussion to unmentioned or unsolved problems, or vice versa; and 6) penetrating questioning. Nineteen of the 42 verbal interaction categories were defined as dialogue categories. Both the creativity criteria and the dialogue categories were found to be directly related to the occurrence of creative contributions in the sample classes. A 29-item bibliography and appendixes are included. (Author/MJM)

AUTHOR'S ABSTRACT

This study was executed by the audio taping and observation of 44 actual classroom science teaching sessions. A verbal interaction analysis instrument was devised, and then refined after a pilot study. The final instrument consisted of 42 interaction categories, six of which were creativity indicator categories and were the criteria used for identifying creative contributions of the students. These six criteria were as follows: (1) The expression, by a student, of an idea which the teacher did not present. (2) Expressed preoccupation with an idea or problem. (3) A statement or contribution which clarifies or summarizes the ideas of the teacher or fellow students. (4) The expressed desire to explore a problem or project beyond current knowledge or classroom material. (5) The expression of an idea which relates classroom discussion to unmentioned or unsolved problems or vice versa. (6) Penetrating questioning.

Nineteen of the 42 verbal interaction categories were defined as dialogue categories. Both the creativity criteria and the dialogue categories were found to be directly related to the occurance of creative contributions in the sample classes.

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FINAL REPORT

Project No. 9-G-043

Grant No. OEG-7-9-530043-0140(010)

AN INVESTIGATION INTO FACTORS WHICH REINFORCE OR DETER CREATIVITY IN CHILDREN

Stephanie J. Kubicek

University of Houston

Houston, Texas

June 15, 1972

The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgement in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education Position or policy.

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ACKNOWLEDGEMENTS

Acknowledgement is gratefully given to the Houston Independent School District, The Kinkaid School, and other Houston area independent school districts and private schools who so graciously permitted us to know and work with the teachers and students who provided us with the valuable data collected in this study.

Thanks is also extended to Mr. Fred Prince, for his discernment of the need we hoped to alleviate with the findings of our work, his valued criticism triggered our initial endeavor.

A special acknowledgement must be given to Jal S. Parakh, Ph.D. whose superb treatises inspired the exacting and critical recording of our own efforts.

Without the assignment and encouragement of my senicr advisor, professor, and project director, Silas W. Schirner, Ph.D., this work would never have been conceived much less attempted.

Assistance and encouragement provided to me over a period of more than two years by my family and understanding friends has been responsible for my indefatigable pursuit of a mission increasingly more challenging as the time and study went on.

To my editor-in-chief, my mother, Mrs. Carrol Mosheim, there is no way to adequately express my indebtedness. God bless her!

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SECTION I: SUMMARY

The problem involved in this study was to design an instrument which would illuminate that atmosphere which is most favorable to the creative process. To the extent that creativity is expressed verbally in the classroom, verbal interaction analysis is an excellent method to study creativity in an ordinary (non-test) classroom situation; and so a 42 item verbal interaction analysis category scale oriented toward creativity was implemented. In this scale, creative activities were identified according to the following criteria: (1) The expression, by a student, of an idea which the teacher did not present. (2) Expressed preoccupation with an idea or problem. (3) A statement or contribution which clarifies or summarizes the ideas of the teacher or fellow students. (4) The expressed desire to explore a problem or project beyond current knowledge or classroom material. (5) The expression of an idea which relates classroom discussion to unmentioned or unsolved problems, or vice versa. (6) Penetrating questioning.

Analysis of the classroom verbal interaction was executed from tape recordings of 44 science sessions, representing 11 5th grade science classes from 5 widely separated (geographically) and diversified schools in the Houston area, in an effort to discover those techniques which will aid the teacher in recognizing, encouraging, and developing the creative potential of all of his students. Many such techniques were discovered and are painstakingly catalogued in the paper.

The author defines dialogue as the atmosphere most likely to harbor creative activity, and gives a thorough description of this atmosphere, both in terms of attitudes and of verbal interaction categories which engender, nurture and refine creativity. She further enumerates categories, with benefit of data analysis substantiation, which propagate and/or indicate dialogical interaction. These categories are explicitly designated as "Dialogue Categories". A computation called the "dialogue percent", which is calculated by dividing the total frequencies of all the dialogue categories by the total interaction frequency, was found to correspond with the amount of creative interaction in any given class.

SECTION II: INTRODUCTION

Purpose.

The purpose of this study is to investigate creativity and to discover why it does not thrive in the ordinary school system. Inferences that creativity is on the wane in our country,[27] and indications of the stifling of creativity in the classroom in our present system[21,12] charge the educational researcher with the responsibility of defining creativity, describing creative ability, and then setting up criteria by which creative activity can be recognized and identified. It is creative activity, and not the creative product or creative genius, which this study investigates. It is our hypothesis that practically everyone is able to act in a creative manner, though not to the same extent or in the same fields of endeavor.

Some schools in the United States, following various experimental curricular methods have demonstrated that average children, in a good learning environment, engage in creative activity as naturally as they engage in spelling and arithmetic.[3] This creativity in the "nonexceptional" individual, may take no prizes, nor its product be placed in museums, but it is very important in the growth and development of the individual. It then becomes the purpose of this study to discover a means of perpetuating this delicate trait by determining what factors in verbal interaction in the classroom tend to facilitate or inhibit creative expression.

Related Literature.

One of the essentials of creative production is an environment which expects and encourages it.[27] This necessarily involves course content, grouping for instruction, teaching methodology and administrative procedures.[28] More basically, it involves the willingness and ability of teachers to recognize creative ability and to strive for the proper classroom atmosphere which encourages and develops it.

Creativity, as we use it in this study, is not viewed as a special gift possessed by a limited few, but as a capacity possessed in some degree by all human beings.[4] The literature is full of intensive studies of exceptionally gifted children and adults, their characteristics, preferences, problems and biographies, sufficient to give

substantial data from which to choose criteria for recognizing creative ability in the less outstanding individual.[17,25,26] The Minnesota Studies of Creative Behavior have developed a set of alternate form general purpose batteries of creative-thinking ability tests, applicable from kindergarten through graduate school.[21] These tests have been the object of much research relative to their validity and test-retest reliability. The Torrance Tests for Creative Ability have proven their value in the measurement of creative ability. They also have been used in studies demonstrating the apparent stifling of creativity in the school systems.[21] This condition definitely exists, and there are different schools of thought as to why it happens. Some blame the school system, the curriculum, the teacher; while others consider that there is a period in a child's development when he naturally diverges from creative efforts, while occupied with attaining the tools (knowledge, background) with which to become creatively productive once more. This author is convinced that both are true and concerns herself with assuring the return to creativity. Creativity tests have been compared with intelligence tests, where their value has been proven in measuring the actual intellectual ability of the individual, and in predicting success or aptitude (more so in many cases than IQ tests).[10] However, tests, no matter how exhaustive, have definite limitations and creativity tests are no exception. Torrance states that no single area of observation or test taps all of the child's resources for creative thinking and, that the same test or kind of observation may not be equally valid or adequate at all age levels.[21] It is difficult to devise a test that allows for all the variations of individual reactions to the "test situation". Some highly creative children have difficulty in communicating them orally. So we must be prepared to evaluate creativity whenever and however it occurs in the classroom; in essence, to recognize the behaviors which are indicators of creative tendencies. It has been pointed out in the literature that some of the characteristics of creative individuals are not easily accepted, handled or tolerated by some teachers.[19] In fact, these characteristics are often considered to be objectional behavior and not recognized for what they truly are, namely observable characteristics of creative activity. Therefore, in addition to creativity tests, there is a definite need for non-test methods of identifying creative activity in the classroom, if, indeed, we are to preserve this very desirable trait in our culture and our people.

Background and Discussion.

Since creativity cannot be turned on at the moment we need to test for it, we must be aware of the atmosphere in which it is likely to eventuate, in order that we can be on the alert to recognize creativity any time it occurs.

Importance of Dialogue.

It has become evident during the course of this study that creativity (or more specifically, creative verbal activity) occurs in classrooms where dialogue is possible. Although this statement rightfully belongs to the section on findings, we have placed it here because we wish to make it perfectly clear what dialouge means to us, and therefore the topic belongs to background and discussion as well.

Dialogue is to creative verbal interaction what blood is to the body; when the flow of blood stops, the body dies. Dialogue is more than a method of communication; it is communication itself; for dialogue is that type of interaction with which an individual reaches out, and tries to understand as well as to be understood. When dialogue ceases, understanding falters and fails; confusion, resentment, indifference and, in extreme cases, hate results, because dialogue is the essential factor of all satisfactory and gratifying human relations whether in business, in church, in education, in society or in the family. Dialogue is that relaxed, unstrained interaction where ideas, feelings, and meanings can flow freely. But, it must be mutual and proceed from both sides and the parties to it must persist relentlessly.

It must not be presumed that because dialogue, once achieved, is relaxed and beautiful that it is easy to accomplish. On the contrary, it is most difficult, even in one to one interaction, and occurs rarely. Why? Because there is risk in speaking the dialogical word (that is entering into dialogue) but when two persons undertake it and accept their fear of doing so, the spring of intensive inquisitiveness is released and interpretative daring is unleashed bringing forth deeper and deeper penetration and insight into the problem. (Here it should be pointed out that the subjects or objects explored by dialogue are not always problems; but can be ideas, feelings, or even the participants themselves.) These adjectives (intensive inquisitiveness and penetrative, insightive interpretative daring) are the very same ones we have chosen to use to describe creative activity and, as we explain the design, methods and findings of the

study, the reader will come to understand what we mean by them and why it is these and no other adjectives that we chose.

Philosophical Background.

The very illusive and diffuse nature of the subject of this study, prohibits our labeling the design in terms associated with deductive logic. Neither have we composed a set of tight hypotheses which will ultimately and objectively be accepted or rejected. Never-the-less we proceed from a well defined purpose and a clear set of objectives, and the assumptions and premises we propose stem from deep philosophical convictions about the nature of man, concerning: (1) knowledge, (2) learning, (3) creativity and (4) teaching. Briefly now we express those convictions.

First, that man has the innate capacity to discover ultimate reality (KNOWLEDGE) and a further ability to fathom the interrelation of phenomena (knowledge of a higher order). That is to say, the mind of man has the potential of possessing truth, be it absolute or relative.

Second, that man, while cognizant of the fact that the universe is a coherent system, orderly and not chaotic, is at the same time, able to observe change and seeming disorder in the universe. This causes in him an uneasiness (Piaget calls it disequilibration) and he struggles to satisfy his sense of order, or to regain equilibrium.[13] In other words, man realizes his ignorance (becomes sensitive to a problem), which causes discomfort (inquisitiveness), which furnishes the motivation (self-motivation) to act on stimuli or information in such a way that truth becomes congruent with reality; knowledge has been assimilated[13] (LEARNING has taken place), and comfort or equilibrium has been regained.

Third, that this type of learning (i.e. self motivated activity brought about by sensitivity to a problem) is natural to human beings, enjoyable to human beings, and therefore, most likely to utilize the highest potential of human beings, bringing about creative activity or creative productivity (CREATIVITY).

Fourth, it should be the aim of education (TEACHING) to

develop the full man to his greatest potential. The above three statements then illuminate the strategy of teaching to be: bringing students to the realization of their lack of knowledge (helping them to develop a sensitivity to problems), convincing them of the possibility of remedying the situation through their own efforts (establishing in them a faith in the order of the universe and furnishing exterior motivation), and finally introducing them to the satisfaction of equilibration through their own efforts.

Teaching has been defined by Hatch as, "what is left after a teacher stops transmitting information."[9] Therefore, ever mindful that the process of education and of learning is unending, teaching should initiate that self motivated activity which will, then, not stop in the classroom but will continue to bring to the students the reward of their inquisitiveness - the knowledge which they seek, the product of their creative efforts, namely, true learning, discovering, and creative achieving. Even though all that has been created is a new concept in the mind of the student, which he then is able to express in his own unique way because it has become a part of him (assimilated knowledge), we must consider that the activity producing that "unique" concept bears the earmarks of creative activity or creative thinking. This is the type of activity which, if nurtured, has the potential of attaining for the individual the heights of eminent creative productivity.

Objectives.

In our description of creativity in the average individual (above), we have alluded to the quality of tenuous fragility in the early stages of creative development. It is altogether possible that the creativity of exceptionally gifted individuals is equally fragile in its later stages; but rather than allow his creative expression to be stifled, the individual retreats from society, and sometimes from self. This might help to explain the frequently observed eccentric and disordered personalities of some of the noted creative geniuses of history. This is not meant to insinuate that all, or even the majority of the highly creative individuals are maladjusted, for the very qualities which make a person creative are those which lead to the development of well adjusted, stimulating, healthy (of mind and body) individuals under normal circumstances; and these qualities are undoubtedly what have enabled certain unfortuante individuals to perservere in spite of environments which were unsympathetic to their particular genius. We then charge the teacher with the responsibility of recognizing,

encouraging and developing creativity; and the objectives of this study are aimed at aiding the teacher in this grave responsibility. These include the following:

1. To bring teachers to think of their pupils as having more or less creative ability rather than as having creative ability or not having creative ability.

2. To demonstrate that creativity is not confined to the exceptionally gifted child.

3. To develop simple criteria by which creativity in the individual may be easily identified in the classroom.

4. To demonstrate that creativity can be stifled and retarded in the classroom.

5. To demonstrate that creativity can be induced and developed in a proper classroom atmosphere.

6. To demonstrate that certain teacher techniques and peer interactions affect creative expression.

SECTION III: METHODS

Problem.

The enormous problem which faced us in the pursuit of these objectives was to develop an instrument sensitive enough to register an atmosphere which was sensitivity itself (see the description of the sensitive atmosphere necessary for dialogue, p. 4). We planned a pilot study for this purpose; as it happened, not only the pilot study, but this entire research project was involved in the perfection of the instrument.

The problem involved two tasks: (1) to develop a set of criteria by which verbal creative behavior could be recognized during classroom activities, and (2) using these criteria for identifying the creative activity when it occurred, to design an interaction analysis scale which would not only enable the investigator to isolate the creative behavior, but also to search the preceding and following verbal interaction for factors which effect creative behavior.

Definition and Criteria for Creativity

The first phase of the problem was relatively simple. Related research had already laid the groundwork, with ample definitions and descriptions of creativity: some orientated toward the person, others the product, others the press and still others the process. Person, Product, Process and Press are referred to as the four "P's" of Creativity; press representing the environment in which the product of creativity appears, as a result of the creative processes performed by a creative person.[24] The use of all four of these was essential for our purposes, with an ever cautious awareness of their interrelationship.

The classical definition of creativity is the ability to produce or quality of producing something new, unique, original, not-before-existent.[3] Torrance defines it as a process through which difficulties, gaps in information, and incongruities are sensed, and resolution of the resulting tension is sought through questioning, searching for additional information and new relationships, guessing or hypothesizing, testing these hypotheses, correcting them, and communicating the results.[15] If this appears a complex definition, it is because creativity is itself complex. The weight of the

evidence indicates that creativity is not a unitary ability, but that it can be demonstrated in a variety of characteristics which are dependent on the individual involved, and the discipline in which he is expressing his creativity.

A creative act may express a likeness among phenomena which has not been thought of before, or a new unity in the variety of nature. Induction in science, which is always partly speculative, infers a new unity which the facts do not strictly imply. Creativity in the arts occurs as a single mind comibnes into a unique whole, elements which may have appeared separately in other productions, but because they are combined here and because of the particualr way in which they are combined, the artist is said to have produced an original--hence he has created, at least in the common sense of the word.

When a student is creative he goes beyond the information he has been given to generate additional ideas. Such a student, given proper encouragement and provocation, will often present an idea which the teacher did not express, or improve on systems, concepts or ideas that already exist.

Creative children demonstrate flexibility in a variety of situations. If their first attempt at a solution is not successful, they are not terribly distressed, but have numbers of other approaches that they are eager to try. Ambiguity is a challenge, and they enjoy highly speculative hypotheses. They are intuitive and capable of analytical observation. Having a strong sense of self, coupled with a goodly measure of self-confidence and sense of humor, they often employ this analytical ability and insight to introspection and examination of their environment for the purpose of maintaining a balance between the two. They are curious and imaginative and have a sensitivity to problems driven by internal motivation to carry the investigation of these problems to completion. When encouraged and not stifled, this internal motivation overcomes their sense of self so that they forget all but the challenge before them, and become completely preoccupied with the problem at hand. The motiviation of a child pursuing a creative activity often exceeds his motivation in other instances. Here a usually nonproductive, or shy, retiring child may be seen to persist in penetrating questioning to obtain closure, and to persevere in an idea or project far exceeding his usual performance, even to the point of further investigation on his own, or attempting a project independent of others.

Creative children have an ability to handle variables (as long as these variables and complexities are held within their ken) and to recognize when new variables have been introduced.

They can work with complexities without getting confused, organize them and are often found able to clarify a teacher's statements or the confusing contributions made by other student's participation in a given discussion.

Because the aim of education should be to develop all students to their greatest potential, teachers should credit all students with having the potential for creativity. Then they will begin to search for and try to develop and encourage that creativity in all their students. This study concerns itself with the factors present in the classroom atmosphere which facilitate or stifle creative action and expression. Guided by Torrance in his Attitude Patterns of Creatively Gifted High School Seniors: and work by Arnold Toynbe and William Walker, and others,[6,7,21,25,27,28] the following criteria were chosen for the isolation of creative ability in our study, i.e. on a verbal basis, in an actual classroom situation. (See also Appendix A, p. 68)

1. The expression, by a student, of an idea which the teacher did not present.

2. Expressed preoccupation with an idea or problem.

3. A statement or contribution which clarifies or summarizes the ideas of the teacher or fellow students.

4. The expressed desire to explore a problem or project beyond current knowledge or classroom material.

5. The expression of an idea which relates classroom discussion to unmentioned or unsolved problems, or vice versa.

6. Penetrating questioning.

Designing the Intreaction Analysis Scale.

In devising the interaction categories, we used the Flanders Interaction Analysis (the one most familiar to us) as a model. We enlarged certain categories, namely teacher questioning and student initiated responses, in order to illuminate those interactions which we felt might effect creative verbal contribution. The student initiated response included the category 9C (student initiated creative contribution), the use of which was governed by fulfillment of one or more of the

six criteria for creativity indicators described above. (Appendix B contains the Original Plan for Modification of the Flanders Interaction Analysis, p. 70). The category system used in the final analysis of the data is the result of three subsequent revisions of the instrument, and is quite a departure from the original plan. Because of its length, an entire section of this work is devoted to description and discussion of the forty two (42) item scale. (A brief summary of the Verbal Interaction Analysis Categories Oriented Toward Creativity appears in Appendix C, p. 74).

Procedures.

Sampling.

The sample consisted of 281 students. This represented eleven (11) classes and nine (9) different teachers in five (5) different Houston area schools: one private school and four schools in the Houston Independent School District (HISD). After securing permission from the HISD, form letters were sent out to the school principals. The schools receiving letters were selected because the principals were either known to the principal investigator, or recommended to her as being interested in this type of research. Undoubtedly many other schools would have been equally willing and suitable to participate. An effort was made to select schools which would give us a cross section of the various cultural, scholastic and economic backgrounds of the students in the area. This background information was obtained by the principal investigator during personal interviews with the principals before commencing recording. Only those principals who had indicated their willingness to participate in the study were interviewed. All names of schools teachers and students are withheld, but a description of the schools participating, and the classes from each appears in the appendix. (Appendix D, p. 76). Samples of the form letter sent to the principals, and the Research Participation Form given to the teachers appear in Appendix E. (pp. 77-80)

As this investigator had particular interest in the teaching of science, all classes recorded were fifth grade science classes. The fifth grade was chosen as a good place to test the sensitivity of our instrument for detecting creativity and describing the creative atmosphere, since it has been sighted in the literature as a point in our education system where creativity is absent or infrequent.

Data Collection.

Four successive audio tape recordings were made of each participating teacher. By successive is meant that, once we began taping the science period of a particular class, we taped consecutive science periods until we had taped four, regardless of whether those science periods occurred daily, weekly, or bi- or tri-weekly.

The analysis of the first recording for each class (referred to as session I) was used to establish a pattern of events, and the data were not included in the final analysis of data. This was done for several reasons: to allow the investigator to become sensitive to teacher technique and class atmosphere; to allow the investigator to familiarize herself with the names of the students and their approximate locations on the seating chart; and to offset the affect of the presence of the observer and the tape recorder on teachers and students, i.e. to "break the ice".

During the recording session the observer recorded the sequence of student speakers on a seating chart (Appendix F, p. 84). The seating chart contained squares representing the locations of the students when they were at their desks; and the squares were identified both as to student name and student identification number. The observer sat or circulated in the room during recording sessions following every step of the interaction. Each time a student spoke, a consecutive number was tallied in the appropriate square on the seating chart. Thus, if student 001 was the first student to speak, and student 003, the second, they received a 1 and a 2 in their respective squares on the seating chart, and so on. Then if student 010, the forty fourth speaker, carried on a conversation with the teacher in which he or she (the student) spoke two times, a 44 & 45 were entered in square 010. Thus each student contribution was consecutively numbered as they occurred chronically on the tape.

The Sequence of Student Speakers Form (Appendix F, p. 84). was used in the analysis of tapes to identify each student's contribution to the interaction of the class. Because it was paramount in this study to examine the effect of classroom verbal interaction on the individual, all student contributions had to be identified. Since student's voices are often difficult to differentiate on tapes, and there was considerable time lapse between the recording and the analysis of the tape recordings, we found that the painstaking execution of the Sequence of Student Speakers Chart - with key words entered in appropriate squares occasionally to aid the tape analyst in proper orientation in the class interaction -

was an indispensable step in the recording procedure. Another technique which greatly facilitated tape analysis, was the underlining of numbers (on the Sequence of Student Speakers Chart) of contributions considered at the moment to be unique or noteworthy by the observer-recorder. As mentioned above, key words were sometimes jotted by numbers in the squares to aid the analyst later in keeping her place while comparing the recording to the Seating Chart. Other notes, such as unique physical settings of the classes or notable techniques which would not be discernable on audio tape, were often written on these charts making them valuable assets during interpretation as well as analysis of data.

Tape Analysis.

It became obvious during the pilot study, that the observer who had been physically present during the recording sessions, must also be the one to analyze the tapes; and any strategies that would help the analyst to recall the actual circumstances during recording (such as the notes made on the seating chart) were very helpful. The length of the sessions for each teacher, and the time lapse between recording and analysis, helped to eliminate bias; for it was all the analyst could do to keep up with the interaction and to code it. However, to be sure that a great deal of significant bias was not introduced, tapes were reviewed once more by the same analyst. Any time there were differences in the first analysis, or there was any doubt in the analyst's mind about the way an interaction should be coded, the classroom situation was reviewed (from the notes and personal recollection of the recorder - always the author) with another person, usually the project director, and the category explanations reviewed before final decision was made on how to tally a given questionable situation. These conferences resulted in considerable clarification of the six criteria for indicating creativity, and of the interaction categories themselves, and then, repeated tape analysis of all tapes in light of the new clarifications. It is in this manner also, that deletions and additions were made in the instrument.

Tape analysis required four interdependent maneuvers:

1. Coding verbal classroom activity using the interaction analysis scale
2. Identification of students' contributions
3. Isolation and verification of creative verbal behavior
4. Tallying the interaction analysis Matrix

For the sake of clarity, these four steps will be described separately below.

Step 1: Coding verbal classroom activity using the interaction analysis scale. This was done on an Interaction Analysis Coding Form (Appendix F, p. 83). While listening to the tape recordings the analyst wrote down the category code of the interaction she had just heard. Unless the interaction category changed more often, the analyst recorded a code every three seconds. (It is very important that the timing be consistant - this is not difficult once the categories have been used enough to commit them to memory and differentiate one from the other). Some classrooms carry on a very rapid interplay - in this case a category should be recorded every time the interaction changes, even if it occurs within the three second interval - this results in a greater total number of codes recorded for any given time span than the theoretical 20 codes per minute would yield. The rule for actions which were sustained longer than a three second interval was to re-tally the same category at three second intervals until the action changed.[1]

Step 2: Identification of students' contributions. Following the interaction as recorded on the Interaction Analysis Coding Form simultaneously with auditing the tape recordings, the tapes were stopped with each student contribution, and the student's name placed in the margin of the Interaction Analysis Coding Form next to the appropriate action or set of interactions. The students were identified either by the teacher's calling them by name on the recording, or by reference to the Seating Chart mentioned above (Appendix F, p. 84). As each consecutive speaker was identified, their corresponding numbers were marked off on the seating chart, to assure the correct assignment of each interaction to the proper student. In cases where the teacher consistantly identified the speakers by name either before or after their contribution, this task was greatly simplified; on the other hand where this was not done, the Sequence of Student Speakers Seating Chart, was indispensable, along with the key words noted during the recording sessions, enabling the tape analyst to check his or her place in the recording against the key words attributed to the various students on the seating charts.

Step 3: Isolation and verification of creative behavior. Certain of the creativity indicators (represented by the symbol "9C" - Appendix C p. 75) could not be decided upon in the initial analysis of the tapes described in step 1 above. We refer you now to the six criteria for identifying creativity (Appendix A, p. 68).

Criterion 1, the expression of a unique idea which the teacher did not present, could be determined by virtue of having audited the preliminary session (session I) for each class. Likewise criterion 3, clarification or summarization with insight, could be easily determined on the spot. Criterion 5 like criterion 1 could be decided with a knowledge of what had gone before in the classroom. Criterion 6 could be decided easily within several interactions of the initiation of the questioning. However, criteria 2 and 4, which expressed preoccupation with an idea, and the desire to explore an idea, respectively, relied on the action following (sometimes as far removed as to be in another recording session entirely) before they could truly be confirmed as creativity indicators.

In order to verify the potential creativity indicators another form was needed, the Creativity Verification Form. During the initial interaction coding, all potential 9C's were starred (*) and recorded by two alternative codes separated by a comma (,): the 9C category and the alternative 9 category. Then the tapes were audited again. Every statement that was categorized as a 9C was listed on the Creativity Verification Form, so that it could be reviewed and challenged. The starred statements (Possibly 9C, but still undecided) were also listed, (in order as they occurred along with the 9C statements) and enough space was left to enter follow-through if it occurred. Entries were made on the Creativity Verification Form (Appendix F, p. 82) in the following manner. Each page was headed with the code numbers for the school, teacher, class, and session I, II, III, or IV. At the left of the page the tally number of the particular coded statement was entered (for easy location on Verbal Interaction Coding Form), followed by the student's name -- and enough of his statement to recall clearly to the analyst's mind the topic and situation. The entire sample of the class (that is all the sessions for any given class) were audited in order to enter follow-up statements which would verify potentially creative contributions by the students. When sufficient evidence was found to justify categorizing a particular statement as 9C, that original statement in question was starred (*) in the left margin by its tally number on the Creativity Verification Form. Later the Interaction Analysis Coding Forms were corrected by matching the starred tally numbers on the two forms. If a particular tally was starred on both forms the 9C category was chosen. If it was starred only on the Interaction Analysis Coding Form and not on the Verification Form, the alternative 9 category was chosen.

Step 4: Tallying the interaction analysis matrix. The data on the Interaction Analysis Coding Form was ready to be

tallied on a 42 by 42 matrix. The squares formed by the rows and columns of the matrix are referred to as cells. First the columns of codes were marked off in pairs so that tally 1 and 2 became the first pair, tally 2 and 3 became the second pair, tally 3 and 4 became the third pair, and tally 4 and 5, the fourth pair, and so on throughout the 600 or so tallies in a recording session. The pairs were then entered on the matrix in the appropriate cells so that the first number of a pair indicated the row, and the second number of a pair indicated the column. Thus each symbol or code (with the exception of the first and the last) was used both as the first and then the second tally of a pair of tallies, and therefore signified a row one time and a column the second time. The sessions all began and ended with the symbol 10NP (or non-productive activity) - and so the row column totals were equal when the matrix was completed. For a detailed explanation of the tallying of interaction data on a matrix see Amidon and Flanders.[1]

When the tapes had been completely analyzed (i.e. the verbal activity coded, the students' contributions identified, the creativity indicators isolated and verified, and the matrices tallied for each class) a list was made of each creative contribution, and the actions preceding and following them were studied and noted. It was considered impractical to pursue this procedure by hand, as there were 847 creative contributions dispersed among 20,850 total interactions in the sample. Only the data from the pilot study were analyzed in this manner, but this served to illuminate possible procedures to pursue in computer analysis.

Computer Analysis.

The first computer program written gave printouts of three kinds of data, named Frequency Count Data, Predictor Percentages and Criterion Percentages. Their meaning and use is described briefly below.

1. Frequency Count Data: This data consisted of two lists of the 42 interaction categories in what we will call the reference column on the left. In the first list the 5 actions following the reference category were listed in columns labeled 1 step, 2 step, 3 step, 4 step, and 5 step, where 1 step represented the action adjacent to (or immediately following) the reference category, and 2 step represented the action once removed from the reference category, and the 3 step represented the third action to follow the given reference category, etc. In the second list the 5 actions which

preceded the reference categories were listed in the same manner as described for the first. This arrangement of the data gave us the number of times any given category was preceded or followed by any other given category immediately, one category removed, two categories removed etc., for the total sample. We were later able to obtain this same information on the individual classes, by altering the program so that it could be applied to the individual class data cards instead of to the entire sample.

It would also have been very desirable to have a frequency count of the number of times a particular category preceded another category or followed it, anywhere within five steps of the reference category - however, writing such a program was not within the scope of this study.

2. Predictor Percentages: The predictor percentages represented the number of times any particular category was followed by another in a given position (such as step 1, step 2, step 3, step 4, or step 5 - described above p. 16) divided by the total frequency of occurrence of that category. For example we could find out, of the total number of category 21's that occurred, how many of them were followed by 95's (see Appendix C for category descriptions). As with the Frequency count data, this information was obtained for 1 step, 2 step, 3 step, 4 step and 5 step; but not for the combination of 1 through 5 steps. This data, originally given only for the total sample, was later computed for each individual class separately.

3. Criterion Percentages: The criterion percentages took a given category (95 for example) and gave the number of times it was preceded by each other category as a percentage of the total frequency of the original category. That is to say, it gave the percent of 95's that were preceded by 10's, by 20's and so forth, within 1, 2, 3, 4, and 5 steps from a category, but not 1 through 5 steps inclusive. Again, the original program provided for information on the total sample only, and it was later necessary to apply the program to the data for each individual class separately.

The above three printouts were then used to work out graphical representations of responses that preceded and followed verbal creativity indicators. This process, however, was very slow considering the pages of printouts that had to be examined to trace back one interaction and all its possible pathways for 5 actions preceding, into 9C.

Another program was devised to facilitate the interpretation of the data, which produced printouts which consisted of rows of eleven (11) interactions across the page, with 9C (or rather 95, the symbol for the initial 9C of any creative contribution) as the criterion (or center action) - and giving the five interactions immediately preceding and the five interactions immediately following the 95. The data were printed out in three different sequences.

a. Natural Sequence: chronological order of the occurrance of the 95's in the total sample.
b. Predictor Sequence: in order as to the code numbers of the categories leading into the 95's in the total sample (to determine if there existed any key patterns into or out of 95). Unfortunately, this sequence only ordered in the first step data and therefore could not be used for the purpose intended; as no more time was allowed - we did not rewrite the program.
c. Criterion Sequence: in order, by the identification number of the student who contributed the 95. This again for the total sample.

SECTION IV: INTERACTION ANALYSIS SCALE

Development.

A great deal of the current educational research is focusing its attention on verbal interaction analysis, and for good reason. We have already expressed the need for non-test ways to identify creativity in the classroom; and charged the teacher with the grave responsibility of discovering and nurturing this very desirable trait. To the extent that creativity can be carried on verbally in the classroom, verbal interaction analysis seemed the natural instrument to use to provide the teacher the necessary insight with which to realize this charge. Ambitiously we aspired to a universal utility for our instrument, not wishing it to be limited to any particular grade level, or subject matter. In spite of the care and thoroughness with which the categories were written, the pilot study revealed that they (the categories) were inadequate to describe all the significant interaction, even in those twelve tapes - which were samples of only two teachers' techniques. Furthermore, with each new teacher that we taped, we encountered techniques which were not applicable to our existing categories; necessitating additions to the interaction scale. There were also categories which were little used by the teachers in our sample, which might be applicable in other grades or other subject studies. Although the instrument was already cumbersome (due to its size), it was found that the addition of categories made coding more time consuming at first, but not more difficult. The difficulties were encountered in the beginning when categories lacked clarity, or were not concise; and with each alteration of the scale (even though this more often involved addition rather than deletion of categories) coding and analysis was made simpler. The following pages tell the story of the evolution of the scale for the Interaction Analysis of Pupil Reaction Oriented Toward Creativity, which appears in the final form in Appendix C, (pp. 74-75).

General Design.

The initial plan for the general design of the instrument was to expand the teacher questioning category and the student voluntary response category in the Amidon Flanders revision of the Flanders classroom interaction analysis scale (see Original Plan for Modification of Flanders Interaction Analysis, Appendix B, p. 70). But reading the very exacting and inspiring work of Parakh's[14] in his examination of the verbal

interaction in Biology classrooms, encouraged us to completely revise our plan and to write an instrument entirely slanted toward the types of interaction which might effect a student's attempts at, or tendencies toward, creativity. Even in the final instrument, however, there remains a similarity to Flanders in the 10 broad general categories, and in the division between teacher and pupil contributions (Appendix B, p. 71 "Summary of Categories for Interaction Analysis"); but there the similarity ends, for the weighting of the categories is not the same. By this we mean, that the subdivisions within the general categories are not so arranged that, by ignoring those subdivisions we could calculate an "ID ratio" (explained in Appendix B, p. 70) and expect it to be the equivalent of a Flanders ID Ratio.

Explanation of Categories.

The 42 item interaction analysis oriented toward creativity consists of ten broad categories (indicated by the numbers 1 through 10); and sub-divisions within these categories (indicated by significant letters in the titles of the categories). The ten broad divisions are: Accepts Feelings, Praises or Encourages, Accepts or Uses Ideas of Students, Asks Questions, Lectures, Gives Directions, Criticizes and Justifies Authority, Student Talk - Response, Student Talk - Initiation, and Silence or Confusion or Break. (During the ensuing explanation of the categories, the reader may wish to refer to the entire scale at once; a brief summary of which can be found in Appendix C, pp. 74-75).

Teacher Talk Categories.

Category 1U. Accepts Feelings: This category is used when a teacher accepts the feelings or emotions or attitudes of the student. It is differentiated from the various 3 categories (especially 3U) in that it deals with emotions rather than ideas. The category is also used when the teacher apologizes to a student, thanks a student or otherwise shows a consideration for the student's feelings. For instance a teacher might notice student A raise his hand while she (the teacher) is involved in interaction with other students. Although A's hand was lowered in the meantime, the teacher recognizes him with, "A, you had your hand up a while ago, did you want to add something?" - 1U was used to tally that statement. Another instance is when a teacher recognizes a volunteer speaker who has forgotten what he was going to say. Instead of going on to the next student, the teacher

helps to avoid the student's embarrassment, and shows that she truly values him as a person by showing that she understands how a person can have something to say, and then forget it. She says, "Oh, you forgot? Well....let me see, we were talking about...and then D said...and then..." - "Oh, now I remember," says student A. And his feelings as well as his contribution have been salvaged. This type of interaction was tallied first as a 1U (to show the teachers acceptance, or understanding of the emotions involved in the situation) and then, to indicate that she has built on student contributions to encourage the student to remember and to contribute his idea, the categories used are 3B and 2U respectively. Category 1, like categories 2 and 3, indicates some type of reinforcement: the difference being where the emphasis is placed. While category 2 places value on a student's contribution, category 1 infers no such value - rather it infers that, regardless of its value (in terms of validity, conformity or justification) the teacher is interested enough in the student himself to allow him to express his feelings, and to try to understand them.

Category 2U. Praise or Encouragement Unclassified: This category is differentiated from category 1 in that it is primarily reinforcing by giving value to an idea, not a feeling. All of the 2 categories have this general meaning except 2PS, which is direct praise of a student and not his contribution. 2U is used only when the above type of praise or encouragement does not fit into one of the other more specifically described categories; such as giving the student some indication that his contribution was correct. "Yes," "right," "uh-huh," or repeating the student's statement, especially after a correct factual answer to a closed ended question, are categoriezed as 2U. Encouraging a student to speak out and to offer his idea or contribution, whatever it may be is also included in Category 2U.

Differentiating from 4RV: These same words ("yes," "right," "uh-huh") are sometimes used to recognize the next speaker, and not to affirm the previous contribution; in which case a 4 is tallied and not a 2U. Here the analyst must depend on her memory of what actually transpired in the classroom, or the notes recorded on the seating chart by the observer-recorder.

Differentiating from 3U: 3U, the noncommital acceptance of a student's statement rather than indicating its correctness, must be differentiated by the tone of voice, inflection, or the effect on the student, or the situation in general (again as observed and noted by the observer-recorder). In general, the 3U category would be more likely to follow an idea, and the 2U to follow a correct statement of fact

though a teacher might deliberately pass non-commitally over a correct statement, in order to make the students think and continue discussing rather than immediately closing the subject.

Differentiation from 3R: - Some teachers habitually repeat students' statements, while others repeat them for emphasis, or as evaluation. 3R is the acceptance of a student's contribution by merely repeating all or part of his statement. Differentiation here, depends on the familiarity of the analyst with the teacher's technique and the classroom atmosphere - again the observer-recorder's notes are invaluable. When repeating the student's statement is interpreted by the student, or the class as meaning that indeed the statement was correct, it is tallied as 2U rather than 3R.

Category 2PA. Peer Action: With this category the teacher encourages peers to become actively involved in a student's contribution or idea. Note: Students are encouraged and given an opportunity to act, but not directed to act, as they are in the direction category 6OE.

Category 2PS. Praises Student: This category is used to indicate when the teacher is praising the student only and not any contribution he or she has made. The use of 2PS indicates that the teacher for some reason chooses to praise the student over and above what would be called for or justified by his or her contribution to the class. For instance a teacher may be attempting to encourage a shy or new student, or in some cases, showing partiality to a student.

Category 2PW. Praises Work: This category is used to indicate when the teacher praises the work or oral contribution of a student. A statement, good idea, correct answer or work is not merely acknowledged as correct (2U), but in addition, the student who contributes the statement or work is praised, as:

"What a nice graph. It's neat, accurate and understandable, very good, C."

"Yes A, I like that idea."

"Right, B, that's very discerning of you, even I didn't catch that."

Category 2X. Explanation: Here the teacher encourages the student to explain, expand, or elaborate on his idea.

Differentiating from 4B: A question which merely asks for

additional information without specifying what information would fall in this category rather than in the question category 4B, which is a specific question which builds on the information the student has just given. For example: "Would you mind explaining to the class what you mean by rotate,?" would fall into the 2X category; whereas, in the case where the student says, "the moon rotates around the earth" and the teacher replies with the leading question, "And what do you call it when the earth turns on its axis?" It would be tallied as a 4B, leading the student to realize that he has confused the terms "rotate" and "orbit".

Category 2I. Investigation: This category is used when the teacher indicates that the student's idea is incomplete but bears looking into, or that the suggestion which the student has made is worthy of study; she encourages the student to investigate or explore his idea further.

Differentiating from 3D: - If the teacher allows the student to do this during the class period, while the rest of the students are doing something else, it should not be recorded as 2I but as 3D (allowing the student to deviate from class procedure to pursue his own ideas).

Category 3U. Accepts Ideas/Unclassified: There are many ways in which a teacher may accept a student's ideas or contributions without committing herself as to whether they are correct. This in itself is reinforcing to a greater or lesser degree, depending upon how original the idea was which she accepted. 3U catches all the unclassified spillover in this general category. A simple "all right", when it is not meant to recognize the next speaker, but the student is not encouraged to continue, is tallied as 3U.

Category 3B. Builds: The teacher accepts a student's idea by beginning to build on it (without complimenting it - 2PW), expanding the idea or uses a student's statement. Sometimes a teacher may use the statement after a considerable amount of interaction has intervened. Then it can only be considered a 3B if it is clear to the class, who's statement the teacher used, or if the teacher gives credit to the student. In this latter case, it is often very reinforcing.

Category 3D. Deviation: This category applies when the teacher allows a student to deviate from the general class assignment in order to pursue his own idea. This also applies when she postpones the ensuing class activity so that they may observe or take part in a student's investigation.

Category 3PN. Peers Note: Here the teacher calls the

peers attention to, or elicits peer acknowledgement of a student's contribution without expecting peer discussion - 3PD.

Category 3I. Inform: This category describes a situation where the teacher offers to better inform herself concerning the student's subject. Tally a 3I when the teacher supports a student's statement or contribution by offering to increase her own knowledge of the subject - or to obtain resource materials or equipment, admitting her lack of knowledge and also acknowledging the worthwhileness of pursuit of the idea.

Category 3R. Repeats: When the teacher repeats a student's statement, not complimenting, nor questioning, nor indicating that it is correct, but merely as an acknowledgement or acceptance of the statement - the category 3R is used. When in doubt, as to the inference of the repeated statement, effect on the student, rather than teacher's intent, should be the determining factor.

Category 3PD. Peer Discussion: This category is used when the teacher encourages or invites the peers to talk about a student's contribution. Although the statement may occur as a question: - "Oh, did you have something to say about A's subject?", "B, did you find out something on J's question?", "Let's talk about that a minute. J, what do you think about A's statement?", "Perhaps the class would like to try your idea B. Shall we discuss it?" It should not be tallied as an open ended question as long as it is a student's idea they are asked to discuss, and that student has been recognized as the originator of the idea.

Category 4W. What?: This category is used when the teacher, not hearing what the student has said, asks him to repeat it.

Differentiating from 7Q: If "What" is used in a threatening tone, or a chiding tone, which definitely denotes the teachers displeasure and is intended to alter undesirable behavior; such as talking out of turn, or saying something the teacher doesn't approve of, category 7Q should be used rather than 4W.

Category 4B. Building or Leading Questions: All questions in a class (except rhetorical questions and the above 4W) could be divided into open ended or closed ended. However, looking forward to the result of the line of questioning, some simple closed ended questions definitely serve other purposes than fact-fact recall. Questions which build on a student's statement helping the student himself to

clarify or elaborate, or correct his statement, should not be thrown in with simple closed ended questions. Likewise, some closed ended questions definitely lead into larger and more important opened questions. This technique of introducing background information into a discussion through questioning rather than lecture should be distinguished in an analysis: thus 4B represents those closed ended questions which are building on, or leading up to a point. 4B is also used when the teacher asks questions which lead a student or students to realize their own errors in calculations or logic, or deduction or induction.

Category 4OE. Open-Ended Question: This category represents a teacher question which requires no right answer. It is also used by the teacher to "throw out" a prediction or a supposition or hypothesis (valid, or intentionally invalid) for the class to discuss, criticize, consider and argue. In short the category elicits students to express ideas, suggestions, questions, preferences, proposals, and evaluations, or to think critically. This does not, however, eliminate the possibility that the teacher may have definite objective limits for acceptable answers and acceptable behavior during this discussion, in her lesson plan, for the sake of evaulation and discipline.

Category 4CE. Closed-Ended Question: This type of question requires fact, fact recall, or some manipulation of data to obtain the right answer. Only one right answer is assumed, even though it may be worded differently, the meaning is the same.

Category 4RV. Recognized Volunteer: This category is used when the teacher allows a volunteer to speak. That is to say, that she calls on a child with a raised hand rather than on one who has not volunteered to speak. This category does not indicate the type of question to which the child must respond and therefore may be followed by any category of student response.

Category 5U. Lecture: Gives facts about, or opinions concerning content or procedures; asks rhetorical questions.

Category 6F. Futuristic Directions: In the model scale (Flanders), the 6th category is used only when the student's compliance would take the form of an observable act. However, there are other directions equally emphatic which, though an overt act must eventually be performed, require only mental activity when given. "Remember that statement"; "at the end of class, I want you to remind me of that statement"; "Think now, we'll come back to you, I want your own ideas".

"Remember which suggestions you made, because at the end of the period, I am going to ask you to write them down and hand them in so we can decide what to study in this unit." Such directions fall into category 6F.

Category 6OE. Open-Ended Directions: In this type of direction, it is inferred that the student is to act, but he has a choice as to his action or procedure. Of course statements involving disciplinary reproofs such as, "you may either stop that or go to the office," would be classified as 7S (severe reproach), and not 6OE.

Category 6CE. Closed-Ended Directions: When this type of command, direction or order is given the student is expected to act according to explicit directions, with no choice of action. This should not be a reprimand (7 categories).

Differentiating from Category 7: In order to decide between 6's and 7's, the analyst should constantly keep in mind the general tone of the teacher's influence and her effect on the student. Certain words spoken gently as a reminder by one teacher would be tallied differently than those same statements uttered in a harsh tone and which definitely reprimand, and possibly humiliate, anger or frighten the student. None of these, however, are usually considered 6's in the scale; rather, the 7 category has been divided to handle both the subtle, and gentle as well as the harsh and sarcastic methods of discipline. Therefore, it will generally hold true that a direction which pertains to class assignment, rather than to discipline will fall into the 6's and any indications of disapproval (not error in class work) of deportment falls in the 7 categories. Thus: a statement like, "you're not thinking, I'll come back to you, now think hard, I want your original ideas" would be tallied 7ED followed by 6F. Again, the general tone of the teacher must be taken into consideration and the effect on the student. In this case, it should be gentle and not a sarcastic or threatening tone; otherwise it should be a 7S.

Category 7ED. Evidence of Disapproval: This is the very gentlest and subtlest type of discipline. It is only effective when there is an atmosphere of mutual respect and self-discipline in the classroom.

Category 7I. Ignores: This category is used when the teacher ignores, or deliberately interrupts a student; without any effort to mend the student's feelings (apology). Impulsive, voluntary statements are frequent in some classroom atmospheres. Therefore, it must be quite clear that the teacher did hear the student, before 7I is tallied.

Category 7CS. Changes Subject: This category can be used when the teacher, either disapproves of or is bored with a student's contribution and changes the subject, abruptly. It is not to be confused with a tactful steering of the conversation back to the desired direction, without offending the student and discrediting his contribution.

Category 7PC. Peer Criticism: When the teacher actually elicits or invites peers to join in criticism (of a non-constructive type), negative evaluation or ridicule of another student, this category is tallied. It is a most damaging type of disciplinary action, probably not very effective and certainly not very just.

Category 7S. Scolds: Statements showing strong disapproval, such as severe scolding belong in this category. Also biting sarcasm or extreme self-reference; justifying authority.

Differentiating from 7ED: These same types of things, when expressed without severity, or biting sarcasm, would not be considered 7S, but 7ED (evidence of disapproval, without severe measures). 7S is used only if the teacher speaks harshly and the scolding not only indicates evidence of disapproval, but severe disapproval or criticism of the student's behavior. Again, it is best to judge weight of the statement, by its effect on the students. If the chiding is accepted and heeded good-naturedly, then 7ED is used. If altered behavior is a result of embarrassment, humiliation, fear, or anger on the part of the student and/or teacher, 7S should be tallied.

Category 7Q. Questions: This category describes questions which are intended to make the student realize his error and therefore change his behavior voluntarily. This is another gentle or subtle form of maintaining class discipline - especially self discipline, with a little help or reminder from the teacher.

Differentiating from the 4 (questioning) category: The key to this category is that it should only be used when the teacher's statement affects a change in deportment (behavior), and not correctness of subject or content matter. In the latter case it should be included in the 4B category, as a means of eliciting the beginning of self criticism (of one's own work) and not self discipline. Discipline here requires two forms, the type of discipline which makes one behave courteously and considerately, and the type which makes one conscientious and critical of his work. Both are important in class, and these two categories (4B and 7Q) are indicators of how some teachers help to develop these

self-disciplinary traits in their students.

Pupil Talk Categories.

Category 8U. Unclassified-Response: This category is used to indicate otherwise unclassified talk by students which is in direct response to the teacher; that is, the teacher initiates the contact or solicits the student statement and the answer is specific and predictable. It is also used when a student responds with a specific and predictable answer to a closed-ended question, even though the student may have volunteered to answer the question, by raising his hand.

Differentiating from the 9 categories: The type of response is more important, than the circumstances which bring it about, since the category 4RV (teacher recognizes a volunteer student) is available to indicate whether the response was voluntary or not. Therefore, although 8U most often follows a 4CE (closed-ended question) or a 4B (building or leading question), a 4RV might intervene to indicate that the student volunteered to answer the question instead of being called upon. 8U represents the types of statements that require routine, fact recall, and very little other manipulation of data, to produce a correct answer. All other types of student contributions have specific 9 categories to describe them. For example, when a student volunteers more information than is required to answer the specific question asked, the analyst stops tallying 8U and continues with the appropriate 9 category to describe the student's contribution.

Category 8A. Acknowledgement, Passive: Students give passive acknowledgement of another student's contribution, as in response to the teacher's 3PN.

Distinguishing from 9E: 9E represents reinforcing comments from peers. 8A is usually a collective response, from all or part of the class, and infers no value to the previous statement. When the response, even when solicited by a teacher's 3PN, becomes more than passive, it is tallied as a 9E.

Category 9U. Unclassified Student-Initiated Talk: This category is intended to handle all unclassified talk by students, which they initiate; responses to broad (open-ended) teacher questions, and responses to teacher's 3PD when not otherwise categorizable. For differentiating from category 8U. (see 8U above).

Category 9E. Encouraging: This category is used when a student voluntarily praises or encourages or reinforces his peer's statement with supportive, reinforcing, cooperative, additive, approving or admiring statements. Spontaneous agreement with a peer's statement would fall into this category. Supportive laughter and appreciation of a peer's related witticism is included in this category.

Differentiating from and use with 9BC and other 9 categories: When a student previews his own his ideas with support to a peer's statment, a 9E should be tallied. For example: "That's right, and we should also measure how long it takes for each one to come to a boil." A 9E is tallied first, indicating that the speaker has agreed with his peer's statement; and then a 9BC or other appropriate 9 category for his own idea is tallied. (9BC is further explained below). Likewise, 9E should precede any other category 9 statement which begins by building on or agreeing with or showing interest in a peer's contribution. The necessary element in tallying 9E is that the previous student speaker must realize that his statement has been reinforced or supported.

Differentiating from 9V: 9V, discussed below, describes a student volunteering to take active part in his peer's idea or project. It is not necessary to precede a 9V by 9E, since 9V itself presupposes support of and interest in the peer's contribution, and in fact is just a special case of a type of 9E which was given a separate category.

Category 9BC. Being Critical: This category describes student talk which builds on or constructively criticizes his own or a peer's contribution. (Note: where a peer's statement is built on, and credit is given that peer, a 9E should be tallied first). Correcting a peer's error is included in this category. 9BC is intended to represent efforts toward analytical thinking with self criticism - rather than dependence upon teacher rationale.

Category 9D. Discouraging: Student talk, either voluntary, or in response to teachers' 7PC (invitation to ridicule), which is intentionally disparaging, is placed in this category. Unfriendly teasing, sarcasm and destructive criticism all belong in this category. When in doubt measure the effect on the student, rather than the intent of the peers.

Differentiating from 9E or 9BC: On the contrary, good-natured teasing is frequently an indication of the very desirable atmosphere where constructive criticism among peers is accepted; an atmosphere of mutual respect and good humor. In such a case, the statements would be properly categorized

as 9E or 9BC, depending on the nature of the remark. Occasionally, unacceptable behavior, is met by expressed disapproval of peers without the teacher's having to intervene. Such reproaches from peers fall into the 9D category.

Category 9V. Volunteering: This category is used when a student offers to take active part in a peer's idea or project.

Distinguishing from 9C: 9V is distinguished from 9C (the creativity indicator) in that the idea was not originally the speaker's, but rather his peer's. If the speaker offering his help, should contribute his own unique ideas to that of his peer's, a 9V should be recorded initially, followed by the appropriate 9 (possibly 9C) category. 9V is also tallied when a student volunteers in response to a 2PA (Teacher calls for peer involvement in a student's idea or project).

Category 9C. Creative Contribution: Student participation which fulfills one or more of the six criteria for creativity indicators, namely: 1) original idea or interpretation 2) preoccupation with an idea or problem 3) clarification of variables 4) intensive inquisitiveness beyond classroom knowledge 5) application and transfer of knowledge 6) penetrating questioning. These six criteria are explained in Appendix A. (pp. 68-69).

Category 9PC. Peer-Conducted : This category is used when one peer calls on another to recite... usually it is a person who has been giving an oral report or conducting an experiment.

Category 10P. Productive Silence: Silence, as when a teacher or a student ponders a question for longer than a 3 second interval, is considered to be productive silence. When there are many conversations being carried on at once, such as in a laboratory, or group discussion situation, this category is used to signify, that although uncategorizable, the noise or interaction that was going on was nevertheless productive. Here again, the notes of the observer, recorded on the sequence of speakers seating chart, were helpful in describing the type of situation which precipitated the tallying of 10P.

Category 10N. Neutral: This category is used when parts of the recording are uncategorizable due to technical difficulties with the equipment; as well as intrusions from other than classroom sources. These intrusions might occur during

change of periods for another class, which passed noisily down the hall; the passing of an airplane; another class recessing outside the window; interruptions from the PA system.

Category 10NP. Non-productive Silence: A session always begins with 10NP. Commotion or confusion or chaos within the class is also indicated by the tallying of 10NP.

Category 10B. Break: This symbol serves to indicate that one student's conversation has been followed by a second student's with no teacher statement intervening. For facility in coding, a slash (/) may be inserted, but it should be tallied as 10B on the matrix. This category was virtually done away with in the numerical coding system for the computer since the change of speaker could be detected by a change in the 3-digit series which represented the speaker (See Appendix G, Figure 2, p. 85-86).

SECTION V: FINDINGS AND ANALYSIS

Scrutiny of the interaction analysis data and the observation notes for the eleven science classes, brought out the variables which must be considered as factors in establishing a favorable atmosphere to the creative productivity of the students. The atmosphere of the classroom is brought about by the verbal interaction, the physical surroundings, and the techniques and methods employed by the teacher to present the subject matter; and these factors are interdependent.

Verbal interaction is a vital factor to the extent that ideas and attitudes and feelings are communicated verbally. This factor includes the types of categories used, and how they are used: the use made of questioning; what kinds of behaviors and responses are reinforced and encouraged; discipline and the way it is affected - the types of discipline categories used and the types of behaviors and responses that are accpeted.

The physical surroundings though important, must not be overstressed. Limitations in space and equipment need not be an inhibitive factor especially in today's advanced scientifically oriented curriculum. Scientists have learned enough about sophisticated phenomena, to be able to simplify them and explain them in terms of models and experiments using surprisingly common and ordinary equipment and the newer curricula have taken advantage of these to begin the investigative sciences at lower levels and on lower budgets. Supplimentary materials are plentiful and education centers with their varied facilities are available to many school systems now to make up for the lack of equipment in any one particular classroom.

The presentation of the subject matter by the teacher depends on her own personality, experience, and background or knowledge of the subject matter; and so these must also be considered as factors in the "creative atmosphere" of the classroom. During this study we could not help but observe the differences in personality of the teachers and sense the variety of experience; however, these two factors were not considered except to acknowledge their influence on the other factors (interdependence) and to take advantage of the experience by noting the various techniques they used.

Verbal Interaction.

It was our design to illustrate the verbal interaction factor by examination of the kinds, numbers, and uses that were made in the classroom of the categories in the interaction

analysis scale devised for this purpose.

Predictor Categories.

Examination of the interactions leading up to the creative contributions in the study (that is categories which occurred 1 step, 2 steps, 3 steps, 4 steps and 5 steps previous to the 9C - creativity category) indicates that certain categories lead into the creativity category more consistantly than others. These will be referred to as "predictor" categories - but it must be remembered that the term predictor merely refers to the percent of the frequency that a particular category was followed by the creativity indicator category within 5 interactions. Briefly described, the predictor categories are: 1U - accepting feelings; 2PS - praising the student; 2PW - praising student's work; 2X - encouraging explanation or elaboration; 2I - encouraging further investigation; 3U - accepting ideas unclassified; 3PN - peers note; 3I - teacher inform herself; 3PD - encouraging peer discussion; 4W - what?; 4B - building questions; 4OE - open-ended questions; 4RV - recognizing volunteer speaker; 6OE - open ended directions; 7ED - evidence of disapproval; 7CS - changing subject; 8A - student passive acknowledgement; 9E - student encouraging peer; 9BC - being critical; 9C - creative (divided into initial and sustained - numerical categories 95 and 97 respectively, See Appendix C, p. 74); and 10B - break, between two student speakers.

Table 1 lists the predictor categories and shows in which class the category was a predictor, how many steps from 9C that the category was a predictor, and the percent (of its own total frequency) of times a category led into 9C - i.e. predictor percent. As can be seen from Table 1, some of the categories which were the highest predictors in one class, were little or not at all involved in other classes. This doesn't mean that they did not occur in the other classes, it merely means that they didn't occur within 5 steps of the creativity category in those classes. Since there is so great a disparity between classes, in the categories which lead into creativity, we can hardly determine from the predictor data alone which categories are effective in producing creativity in the classroom. We can merely say that these were the categories most closely involved with creativity as it occurred in our sample; remembering that mere physical proximity does not automatically infer a causal relationship; nor does the lack of it exclude the possibility of causal relationship (see especially discussion of Category 1U, pp. 48-49). However, this is no way diminishes the importance of the proper use of the proper categories in building the proper atmosphere for creativity. This fact

Table 1

Predictor %'s of Categories Leading Most often into the Creative Category.

	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	All Classes
1U										3-11.9 4-11.9		
2PS		1-10.0 3-10.0	1-16.7									
2PW	2-21.0	3-11.8								2-16.7		
2X	1-15.0	1-12.8			1-20.0 4-10.0			1-10.3				
2I										3-16.7 4-16.7		
3U	2-14.0							[illegible]				
3PN		5-10.0 1-10.0 2-10.0										
3I	1-50.0											1-50.0 4-50.0
3PD			2-14.3		2-11.1					2-12.5 3-25.0		
4W	4-33.3							5-16.7				
4B					3-10.0							
4OE	2-14.0											
4RV	1-23.0		1-11.3					1-15.5		1-15.5		1-11.9
6OE	3-11.0 4-11.0								5-12.5	4-11.1	5-12.5	
7ED	2-13.0									3-50.0 4-50.0		
7CS									1-33.3		1-33.3	
8A								3-25.0 4-25.0				3-10.0 4-10.0
9E	1-22.0	1-16.7	1-12.7		1-33.3 5-33.3			1-60.0 2-40.0 3-12.5	3-10.4	3-14.3	3-10.4	1-12.8
9BC	1-22.0				1-50.0 4-25.0 5-25.0			1-18.5 2-12.5		1-14.7 2-14.3		
$9C_i$*		5-16.2	2-13.6		4-27.3 5-18.2	3-20.0 4-20.0				3-50.0		
$9C_s$*		4-12.3	5-10.9		3-25.0 4-33.3 5-16.7							
10B	2-20.0 1-20.0											

1st Number is the number of steps away from 95.
2nd Number is the percentage of times it leads to 95.

will be brought out progressively in each of the ensuing discussions.

Creativity and Questioning.

In looking at classroom questioning to stimulate and encourage creative productivity we must include not only the kinds of questions that the teacher asks, but the way in which student questions are manipulated.

The kinds of questions asked by the teacher are pertinent only when we consider what kind of answers she expects, and gets.

The open-ended question, considered by the investigators to be the type most effective in eliciting creative thinking in students was used with varying results in our sample. In the majority of cases the number of open-ended questions corresponded nicely with the amount of creativity in the classroom, as illustrated indirectly by the dialogue percent data (Table 6, p. 57); however, in one instance, the frequent use of open-ended questions was not sufficient to affect creativity. In class nine, it was the frequency of 4OE's that threw the Dialogue percent data off from the above mentioned correlation. In this class, though questions which would usually be considered open-ended were used frequently, it was found to the dismay of the analyst that these same questions were answered with very cut and dried, "closed-ended" answers; and furthermore, from the reinforcement given such answers, it could be assumed that this was the type answer expected and desired. The one single occurrance of creativity in that classroom lasted for exactly three interactions (i.e. three, three second intervals), and, not being reinforced or encouraged by the teacher, was not further pursued in the classroom by the student. In fact, the idea was never again mentioned in following sessions.

To avoid the obvious misuse of open-ended questions illustrated above, one must carefully consider the point in the interaction in which the open-ended question is introduced, and the manner in which it is stated. In the example which follows, four words in the question make all the difference in the kind of responses which ensued. The teacher opened the class with, "Today we're going to begin the unit on Oceanography. Now,... what do you know OR THINK YOU KNOW about Oceanography?" The children's responses were full of enthusiasm, and very enlightening. It served to give the teacher an idea of the background knowledge her students had, and an opportunity to introduce appropriate vocabulary as it was described in the experiences and contributions of

the students (rather than introducing the vocabulary words first and making the children define them, unmotivated before experiencing them), while pointing out to the student's indirectly, that they already knew a lot about Oceanography and that there were many things that puzzled them and fascinated them about the subject. The discussion of the first questions was followed by, "What would you like to learn during our study of Oceanography?" The children were all primed for this question now; which brings us to the second aspect to be considered in introducing open-ended or "broad-spectrum" questions: the point in the interaction in which the open-ended question is introduced. Although both of the above questions would be defined as open-ended questions, the KEY question is the one which provides the motivation for the activities which will be carried on by the students throughout the unit on Oceanography. It must be carefully planned so that the students have adequate background knowledge and the proper tie-in so that they are able to relate (or transfer) that knowledge to the problem at hand (or the KEY question).

Another effective method of leading into an open-ended question is with an experiment or demonstration that will cause the question to be posed by the student himself. It can also be done verbally by leading questions (category 4B) which bring the student to realize the presence of a KEY question, or to be ready for an open-ended question.

In the sample, one teacher made especially good use of questioning by answering questions with questions. Thus she never handed out knowledge, but rather elicited it from other knowledge in the class. The very didactic and courteously critical personality of this particular teacher was reflected in her students, in the reinforcement provided by one student for another, and the constructive criticism, and the self critical attitudes of the students. The students in this class were resourceful and independent and did a great deal of their work at home, or outside of the classroom, which was revealed in class by the reporting of facts, or the correction of errors, which had been permitted to pass seemingly unnoticed by the teacher in a previous lesson. The level of performance of this class, which often resembled a seminar, far exceeded any of the others, although the general I. Q. of the students was only in the middle range for this particular sample. Although it must be remembered that high level of performance and creativity are not the same, a close relationship is strongly suggested by the related high number of creative contributions found in this class.

The interdependence of questioning and reinforcement is illustrated by the fact that, in some instances, the closed-ended questions were as effective as open-ended. For example, a closed-ended question (4CE) is followed by the solicited answer (8U) and then some ideas of the student's own initiative (one of the 9 categories) as he goes on with his own explanation, view, idea or question about the subject. Another example is the student initiated idea directly following the closed-ended question (4CE followed by 9's) without first giving the solicited or expected answer. These two examples (especially the later) will occur only to the extent that such responses are accepted. This places types of questioning secondary to, related to and dependent upon reinforcement and upon the atmosphere in general. Table II, below indicates the involvement of these other variables.

Table II: Comparison of Frequencies of 4OE and $9C_i$. (4OE = open-ended question; $9C_i$ = initial creative response)

	Class										
Category	1	2	3	4	5	6	7	8	9	10	11
*ff 4OE	47	117	112	77	33	19	8	31	34	32	25
ff $9C_i$	94	35	45	17	11	5	0	30	2	52	22

*ff = frequency

The second pertinent aspect of questioning is the manner in which student questions are received. As has already been cited above, one excellent way to turn a closed-ended student question into active learning, is to answer a question with a question which builds on previous knowledge to lead into new learning. "Tell me a question and I'll ask you an answer", has been successfully employed by teachers and jurists alike since the days of Socrates. Then there are the student questions which are not closed-ended. These are often, unexpected and unprepared for. The best approach to this type of question is first of all, an earnest effort to find out what the student means by the question. Discovering this one thing, often solves the problem. First of all, if the student means to be disrespectful, then a reprimand is in order; if he means to be humorous, then a good natured acceptance or appreciation of the humorous connection should preceed turning the subject back to the topic at hand. The possibility that an earnest need is being expressed in a humorous way should be recognized. Humor often camafloges a creative contribution, and conceals it from the inexperienced eye. Then there is the question,

which the teacher is not prepared to answer, either because it was not a part of the lesson plan, or because she doesn't know the answer. Such a question should still be acknowledged and brought out into the open; and, especially if it can not be investigated in class, its worth should be emphasized on the spot so as to take advantage of the self motivation that is the natural companion of the curiosity that occasioned the question. However, it is better to take the time to explore the question in class if possible. If not, the suggestion that the student explore it on his own time, some encouragement, or the offer by the teacher to increase her own knowledge on the very interesting subject (which in itself is very reinforcing) all of these are certainly in order in response to any honestly presented question. An honest admission by the teacher that she doesn't know, but that she values the question and considers it worth investigating, both saves face, and preserves the self motivation that is so necessary to successful teaching and learning. As has been brought out in the discussion of creativity and dialogue, an atmosphere of honesty and sincerity, and consideration and mutual respect cannot be emphasized enough.

Creativity and Reinforcement.

As has already been mentioned in the discussion of Creativity and Questioning, reinforcement is an undeniable factor in the creative atmosphere. Directly or indirectly, the teacher must communicate to the students the types of behaviors, responses and deportments that are acceptable and desirable, or are intollerable in his classroom. The teacher communicates directly and deliberately through lectures, "sermons" or closed-ended directions. Everything else the teacher says and does communicates, indirectly, his attitudes and values to the students. This indirect communication must be more carefully scrutinized than the direct, since it is dependent upon the individual interpretations of the students. Sometimes the teacher may not be aware that he is indirectly soliciting one particular type of behavior, or favoring a particular type of response - while paying "lip service" to another. The teacher is then dismayed because he does not get the response he believes himself to be soliciting, and student outcomes are less than expected. This was demonstrated in a study of the compatibility of relevant factors concerned with teaching the various curricula; in which it was found that the compatibility of the factors represented by ID ratio, TNT ratio, and the type of course led to significantly greater achievement in most student outcomes.[16]

Careful analysis of the interaction in the classroom indicates that the correct and calculated use of indirect communication

can be very effective. Reinforcement is the tool used to encourage desirable behavior; and withholding reinforcement is often sufficient to discourage responses without correction, negation or reprimand. Therefore, a teacher must be most careful in what he reinforces. If he wishes a specific type of behavior (such as is necessary in learning a particular skill) that and only that must be reinforced and all other behaviors should be discouraged. If, on the other hand he is reaching for diverse responses to encourage critical and creative thinking, he must be careful to take advantage of every kind of acceptable behavior that occurs, and to bring it out as acceptable. The dialogical atmosphere necessitates the graceful acceptance of the possibility of making an error or of needing help, and the reassurance that individual effort is worthwhile, and individual contributions, no matter how small or seemingly insignificant are of value, directly or indirectly, to solution of the problem at hand. These attitudes are learned best through experience. For instance, when a student's mistake has been brought to light, (whether by himself or a peer), the teacher may avail himself of this opportunity to reassure the student's continued effort in spite of his mistake. Statements such as "Oh, we've found a mistake, that's very good! Remember, that is one excellent way to learn...you know, there are many phenomena that scientists would not understand if they hadn't first made the mistakes that caused these phenomena to come to their attention" (Flemming's discovery of penicillin is a classic example). Taking advantage of the opportunity to profit by mistakes is better than all the forewarning sermons about how we "shouldn't be too afraid to make a mistake" or how "we won't always have a RIGHT answer, or a completely correct answer at first." Often the students are unable to believe that the teacher sincerely intends to be tolerant of mistakes and in convincing them, the teacher may go too far and teacher and students alike may become confused when deemphasizing right answers. This can lead to the erroneous conclusion that there are no right answers (which violates the faith most scientists hold in the natural order), and that any old answer will do as long as you try. To maintain a balance between the value of divergent thinking, and diverse or creative ideas on the one hand, and the quest for true solutions to problems and true explanations of phenomena on the other hand, is most important. This can best be done by the balanced reinforcement of both.

Another important attitude that can be achieved by reinforcement is the ability of a student to recognize and admit when he or she needs help. It is not enough to merely have the "brighter" or "quicker" students help the others, this builds a class distinction and defeats the purpose of dialogue, which is to bring out each participating individual to the

maximum of his ability. The student requiring help must be reinforced for his discernment in recognizing his deficiency - and convinced that this one deficiency does not imply inferiority in all things. Permitting the class to discover and alleviate one of the teacher's own deficiencies is one method of achieving this attitude. Honest admission of a deficiency by the teacher himself without discounting the knowledge as irrelevant to the subject is another (such as in the use of Category 3I - see Appendix C).

Once the attitudes are established and dialogue commences, reinforcement then plays an all-important role in selecting and encouraging the types of contributions desired. It was demonstrated several times in this study that creativity will occur, or at least attempts at creative contributions do occur, even in the least likely atmosphere. It was further demonstrated that creativity rarely persists, or develops when it is not recognized and encouraged. For example in class 7, where no creative contributions were tallied, there were instances where student statements seemed to fall into the 9C2 (expressed preoccupation with an idea or problem) or 9C4 (expressed desire to explore a problem or project beyond current knowledge or classroom material) categories, however, as was explained in step 3 of tape analysis, (Section II, pp. 14 & 15) these could not be tallied as 9C unless they were later followed by the proof of the intended pursuit, or motivation. Since these questions and contributions were ignored, discouraged or at least not reinforced by the teacher, none of these potentially creative contributions were followed through and therefore no 9C could validly be recorded for the class. In one particular instance, a question was presented which furnished material for fruitfully occupying the student or even the whole class during much or part of the entire unit. This question could have been expanded into investigations that would have covered as many aspects of the topic as the teacher wished in the time allotted. This question was given an immediate direct answer...and all of its potential was lost!

Another instance of the importance of reinforcement, mentioned in the discussion of Reinforcement and Questioning, is that of class 9, where many potentially valuable open-ended teacher questions (4OE) were answered with memorized answers, which were reinforced and accepted or acknowledged as correct and final. This resulted in a 9C frequency far lower than would have been predicted for this class. (See Table 3, Comparison of Frequencies of 1U and $9C_i$ p. 41) The one occurrence of a potentially 9C4 question near the end of one of the class sessions was met with surprise and politeness by the teacher, but no encouragement or reinforcement. It could have led to a very simple experiment that would have

enlightened the questioning student and others who showed interest when the question was posed. The initial interest of the peers disappeared as they sensed that the teacher did not intend to follow through. In this case the questioning student did persist (possibly due to the initial peer interest) and explain her question to an extent sufficient for it to be tallied as the only creative contribution of that class.

The classes which had a comparatively high occurrence of creative contributions were consistantly those where sincerely offered original ideas were welcomed and reinforced, even though they might have seemed silly, or their immediate pertinence was obscure. Even in these classes, potentially creative contributions, when overlooked or missed by the teachers and therefore not reinforced were abandoned by the students.

Table III: Comparison of Frequencies of 1U and $9C_i$.

	Class										
Category	1	2	3	4	5	6	7	8	9	10	11
f 1U	10	22	30	23	4	4	4	35	11	42	13
f $9C_i$	94	37	45	17	11	5	0	30	2	52	22

ff = frequency

In summary we observed four aspects of the role of reinforcement in regards to creativity.

1. Where creativity is shown to be desirable (by reinforcement) it will thrive in the classroom.
2. When not reinforced or recognized or given an opportunity to express itself and to develop, creativity is stifled in the classroom to the extent that repeated attempts do not occur.
3. It is the overall attitude or atmosphere of the class, and not particular instances, that effect the amount of creativity occurring in a given classroom. That is, the occasional stifling or oversight of a creative contribution in a classroom where creativity is usually encouraged, will not stifle other creative efforts by that student or by other students in the class; and conversely the plea from a teacher that he wishes more creative or independent ideas, when these ideas are consistantly overlooked and brushed aside and other types of responses are reinforced, will have little affect on the increase of creative productivity in his class.

4. Reinforcement can overcome the general attitude of the class in individual instances. That is, in a favorable atmosphere, a potentially creative idea may be abandoned by a student if not reinforced. In this case the converse was not observed, because, in our opinion, the main reason for not stimulating and reinforcing creativity in a classroom is the inability to recognize it. If this were the case, it would be possible for a teacher who recognizes and encourages creativity to overlook a few of the creative contributions of his students and still have it occur; but it would not be likely that a teacher who is not reinforcing that type of behavior would recognize and encourage a creative response if it did occur.

Creativity and Discipline.

Discipline in this discussion will not be confined to methods of maintaining order in the classroom - though it is implied as well. Rather discipline will be discussed as a factor in the overall atmosphere of the classroom, and perhaps the most important factor because without the proper discipline dialogue cannot take place. The proper discipline is that of self discipline, mutual respect, honesty and integrity. It must be established by the example and efforts of the teacher, but is impossible without the cooperation of the students. The factor of discipline, while immediately evident in a subjective and intuitive way by the observer, is difficult to describe, since it so very dependent on the teacher's own personality. The best forms of discipline as they already existed in the classrooms studied, having already been established, were subtle, and unobtrusive; however, we will endeavor to list all the observed phenomena which contributed to the discipline of the class- as well as the effect of the discipline on the creative contributions.

The best atmosphere where dialogue can take place is one of strict discipline. This statement requires a good deal of explanation because it is currently popular to equate strict discipline to inhibited confinement. However, those who consider it so have failed to differentiate between discipline and the norms of acceptable behavior. Let us describe these norms as one variable, and the faithfulness to which they are adhered by students and teacher another variable. It is to this second variable that we refer when we say "strict discipline". It is conceivable that the norms of acceptable behavior in a given classroom could be such that they would stifle all attempts at creativity; however, no such instance occurred in our sample. It was found that

whatever the norm, failure on the part of the students to adhere to these norms, or failure on the part of the teacher to make them clear or to enforce them, made dialogue impossible to achieve and sustain. So let us describe fully what is meant by strict discipline in the classroom and point out the freedoms of the behavior that are possible only in coexistance with this discipline. We can best do this by recounting some of the comments written by the observer on the Sequence of Student Speakers Charts.

Where the discipline of the room is strict there will be little or *"no horseplay before the bell and none after it". There will be "respect and order when the teacher enters, allowing for free interplay and interactions and dialogue when class activities begin".* This mutual respect and consideration then carries throughout the class period; it can be detected even in a noisy room. "Students conduct their own experiments with the teacher standing by and others also watching attentively; students or teacher may offer help if and when needed - an attitude of good-natured, helpful, critical vigilance is observed in the students who are not actually conducting the experiment, while criticisms are accepted with the same good humor."* The type of discipline in the class is often illustrated in the type of humor exhibited, and how the humor is accepted. A sense of humor is the natural companion of a sensitivity to words and problems. Good-natured acceptance of mistakes, discoveries, and deviate interpretations, often humorous ones, is a sure indication that dialogue is taking place and that students are actively participating. In some instances though, humor is self-centered (monological) and disruptive. This type of humor will either be transformed into benefit by a tactful and respected teacher; or in some cases, it is unnecessary for the teacher to act; rather the offender is acted upon by his peers. Peer pressure can be a most effective disciplinary aid. It must, however, be carefully controlled so that it does not become unjust or uncharitable or uncalled-for abuse of a particular student or students. Peers can be quite ruthless and cruel when allowed to be.

Another indication of good discipline in the classroom can be observed when the class is interrupted. For instance, when in a "busy and noisy - even giggly"* room, a knock occurs at the door," "one student says come in, politely, and work continues but in complete silence until visitor (intruder) leaves".* This demonstration of courtesy shows, that the discipline is not something enforced by the teacher,

*Quotations from Sequence of Student Speakers Chart.

and which is confining or demanding. Rather it is a characteristic of self-discipline in which the same respect held for self is extended to all others, even unexpected visitors to the class. In the particular class where this was observed, it was also customary for students to stand when adult visitors entered the room. Whatever interruptions of the interaction dialogue may be occasioned by the inconvenience or distraction allowed to the students while they show graciousness and respect for one another or for visitors, it must be remembered that in this way the teacher is molding the clay of the whole man. Natural qualities of mutual respect and consideration are cultivated, not inborn. And in those classes where the practice of courtesy abounded, "there was also observed a patient and good humored tolerance of the shortcomings or individualities among peers",* which is most conducive to the healthy enjoyment of dialogue. There remains for the teacher but to recognize the creative potential of his student's statements.

Creativity and Teacher Preparation.

In order to recognize the creative potential of a student's statement, a teacher must have a threefold preparation.

1. First the teacher must have an adequate background in the subject matter to be taught.
2. Second, the teacher needs sufficient knowledge of related and diverse subjects to be able to perceive or devise remote connections to the subject in the self motivated contributions of her students.
3. Third, the teacher must have some knowledge of the logical functions of the human mind and of it's potential for creative productivity. That is, he should know what creativity is, basically (not specifically for this would be too limiting) and be able to recognize the indicators of creative tendencies in his students.

Numbers 1 and 2 above allow for a great variety in the possible extent of just what is considered "adequate" preparation in the subject matter. In fact, some of what is required by number two can be gained only by "experience" and practice, or by the observation of teachers who are successful in employing this method of pedagogy. The Criteria for Identifying Creativity defined in this study were meant to aid teachers in the third preparation (See Appendix A, pp. 68-69).

*Quotations from Sequence of Student Speakers Chart.

It is impossible to say what a teacher's background should be in numbers of hours in certain disciplines to prepare him to achieve the development of creativity in his students; but let it be emphasized, that all knowledge is of use in the classroom, and that diversity rather than extreme concentration on one subject, is more likely to succeed where the number of hours is limited. It is not necessary that the teacher have all the facts concerning the subject taught at her immediate command as long as she knows where and how to make them available and desirable to her students, and has ample means of connecting them to other knowledge in other disciplines so as to be better able to capture the diverse interests of all her students and channel them into productivity in the topic being taught.

Creativity and Dialogue.

During the pilot study which preceded this present study, two important things were discovered about the Analysis of Verbal Interaction Oriented Toward Creativity. 1) that the Interaction Analysis Instrument did not lend itself to the extraction of a Flanders I.D. ratio, and 2) that other types of data based on categories that affected creativity would be necessary. Therefore, categories were chosen from the Interaction Analysis scale that were considered to be most pertinent to the accomplishment of Creative productivity in the classroom. (See Dialogue Categories, p. 46)

After the initial analysis of the tapes it was found that creative verbal activity took place when, if and as dialogue occurred in the classroom. It was further seen that the very categories that had been chosen as being pertinent in bringing out the creative tendencies in students were identical with those that would be needed to achieve a "dialogical atmosphere". Thus the title Dialogue Categories was given to the categories listed in Table 2; and a figure derived from the sum of the frequencies of the dialogue categories divided by the total interaction frequency was designated the Dialogue percent, which figure proved most valuable (along with the other factors in classroom techniques, which have already been mentioned) in predicting the frequency of creative verbal contributions that will occur in a given sample of classroom interaction.

To further emphasize the importance of the proper use of the dialogue categories to produce the dialogical atmosphere so vital to creative interaction, we found that frequently

it is the teacher's own ineptness which destroys a very real potential dialogical atmosphere. (Details are omitted to avoid recognition or embarrassment, but the evidence is contained in the data analysis sheets.) In such instances the initial interest and curiosity of the students was inspiring and the fact that stimulating, exciting and most surely creative interaction did not take place was due to the teacher's mechanical adherance to her excellently designed lesson plan (designed for everything except for the allotment of time for creative discussion). The appropriate time for creative discussion cannot really be written into a lesson plan; it must be sensed and taken advantage of when the opportunities arise. For this reason a teacher must be aware of the indications, "signs", and to this end (giving the teacher some guidelines and suggestions to make him aware of these "signs" and able to take advantage of them) this entire study was launched.

The failure of teachers to take advantage of potentially creative situations dots this study (see Creativity and questioning, and Creativity and Reinforcement), even some of the best teachers miss opportunities occasionally, and it is these misses, especially, that show how sensitive creativity is. Creative people are sensitive and, being sensitive, easily sense approval and follow it up; and by the same token sense lack of approval or enthusiasm, and look elsewhere for a "better" idea or climate (since they are also versatile).

Dialogue Categories.

1U (10) Teacher accepts feelings.
2PA (21) Teacher encourages peer to act - take part in student's idea.
2X (24) Teacher requests explanation or amplification of student's idea.
2I (25) Teacher encourages student to investigate his idea.
3U (30) Teacher accepts a student's idea or work, as opposed to feelings.
3B (31) Teacher builds on, expands student's idea, giving credit to student.
3D (32) Teacher allows student to deviate from classwork to pursue his own idea.
3PN (33) Teacher calls peer's attention to a student contribution.
3I (34) Teacher offers to better inform herself on worthwhile student idea.
3R (35) Teacher repeats student's statement.

3PD (36) Teacher elicits peer discussion of a student's contribution.
4OE (42) Teacher asks open ended question, where student has choice of answers.
6F (61) Teacher gives direction which calls for mental activity now, and overt activity later.
6OE (62) Teacher gives open-ended directions, where student has choice of action, but must act.
9E (91) Peer voluntarily encourages, supports or praises a student.
9BC (92) Being critical: a student builds on, corrects his own or a peer's idea in a critical sense.
9V (94) Peer volunteers to take active part in another student's contribution.
9C (95 & 97) Creative contribution; 95 = initial, 97 = sustained.

Effect of the Dialogue Categories:

The dialogical atmosphere begins with honesty. An open honesty of the teacher with his students shows that the teacher has respect for integrity and for his students. There are other attitudes that the teacher must portray to his students in order to open the channels of dialogue and these are considerations and appreciations of their individualities, the joy of learning, the challenge of discovering and describing a problem, and the joy of sharing the problem and participating in its solution. Implicit in these attitudes are then the activities that we call dialogue: speaking honestly; listening carefully for the speaker's meaning; explaining carefully one's own meaning, and pointing out differences of opinion or observation or reasoning, not so much to convince another to your own view, but with the idea of adding to the data to be considered. All these types of contributions are dialogical, and their opposites are, of course, monological. The qualities of courtesy, respect and self discipline are absolutely necessary before this type of interaction can take place.

The categories described as dialogical categories are all a part of this dialogical atmosphere; some helping to bring about dialogue and maintain it once it commences, and others rather indicating that it is present. It is difficult to separate the "causative categories" from the "indicator" categories, because of their interaction. However, for an example, we can say the 1U, accepting feelings, would be more valuable in establishing the understanding which will encourage the expression of individual and unique thoughts; whereas 9BC, critical building, correcting etc., would

indicate that dialogue was indeed taking place, for the critic must have been listening to his peer in order to add to his statement or criticize it. (Remember 9BC is never of the type of criticism that is derogatory, but constructive even if it is not in agreement; 9D covers statements which, on the contrary, are only discouraging and dammaging to the dialogical atmosphere). Nevertheless, 9BC, while mainly an indicator of dialogue, also helps to stimulate more dialogue and thereby has a causative effect as well. During the discussion of the individual dialogue categories this dual connection with creativity will not be repeated, but rather their principal observed effects will be described.

Category 1U, Accepting the Students' Feelings should, by its very definition, be a key category in the accomplishment of dialogue and the stimulation of creative interaction. As can be seen from the frequency of 1U and 9C in individual classes, 1U is always involved, but does not have an outstandingly high correlation with the occurrence of creativity. Neither was 1U frequently a "predictor" of creative contributions. (See Predictor Catetories p. 33) Remembering that predictor merely indicates that a creative contribution occurred within five steps preceding the particular interaction category in question, the latter is not difficult to explain since 1U established the atmosphere, but does not directly elicit the creative behavior as would an open-ended question. The 1U's may also have occurred in the beginning of the semester and by the time the recordings were made for this study 1U's were not often necessary because there was already the understanding by the students that the teacher was willing to accept all deviate answers within the realm of acceptable deportment (which norm itself can vary greatly and influence creative expression as already discussed under Creativity and Discipline). That is to say that perhaps a few 1U's are sufficient to reassure the type of atmosphere which accepts and welcomes the unique efforts at self expression by students. It is also a possibility that individuals are not so often likely to express pure feelings in science classes as in other classes, and therefore there is less opportunity to accept students' feelings in a science class. However, although it may be true that science classes are not so conducive to expression of feelings as are literature, history, sociology, religion or philosophy courses, category 1U also indicated a consideration of students' feelings (even unexpressed); and it was obvious during the analysis of tapes and observance of classes that some teachers were more sensitive to the feelings of their students than others (classes 1,2,3,4 and 10) and the fact that the students were aware of this understanding (sensitivity on the part of the teacher) was obvious in the open dialogue achieved in the classes. It is

the opinion of the author that teachers should thoroughly understand all the implications of 1U, and utilize this category to the fullest extent possible, whether actually expressing 1U's ahead of time, or just keeping in mind all the implications of 1U. In general this requires the constant observation of courtesy, good manners, respect and talking up to the students to the highest possible level of their achievement (never talk down to any student, even babies can sense it and prefer to be spoken to as equals, even though the words of the conversation are reduced to their own level of understanding). A word of caution, concerning over familiarity: it is as damaging as being overbearing or pompous, or authoritarian. The teacher should also keep in mind the difference in interests and reactions, usually attributed to being inherent in the sexes, and take these into consideration when planning and executing her lessons. Then the teacher should attempt to know her students well, their background, and personalities, so as to better understand each individual and how they are likely to react. A teacher who is constantly aware of these things will automatically avoid many offending or embarrassing situations, and will more readily recognize when such a situation occurs or is about to occur, and can take remedial or preventative measures. This mutual awareness of feelings by students and teacher alike produces the atmosphere where awareness of problems and ideas is most likely to exist. This has been aptly designated by some authors as "sensitivity." And "sensitivity" to problems and ideas is a prerequisite to creative productivity. And category 1U is most instrumental in accomplishing this sensitivity.

Category 2PA, the importance of reinforcement, has already been discussed in a general way; the things said about reinforcement apply in varying extents to all of the 2 and 3 Categories. Data are not available as to which are the most reinforcing, and no attempt is made to weigh these categories in this study. What will be discussed here are the reasons each particular category was selected as a dialogue category.

2PA encourages peers to participate in a student's idea. This assumes that a student had an original idea (otherwise it would have been the teacher's idea, and wouldn't have been designated 2PA) or plan of action which has the potential of being a creative contribution. Therefore, 2PA would be reinforcing to a particularly potentially creative behavior, and encourage individual independent or group

activity. In order to participate, peers would have to make the effort to understand the idea and to add their own ideas, stimulating dialogue and creativity.

2X requests that the student explain or amplify his idea. Unlike 2PS and 2PW which praise the student himself, and his work, which may or may not be creative or unique, 2X requires that the student indicate the depth to which he has thought out his idea, which has the potential of bringing out the creative aspect of his thinking.

2I encourages the student to investigate his idea, thus giving him the opportunity to demonstrate his initiative and motivation and possibly his creative ability to solve problems.

3U accepts a student's idea or work as opposed to his feelings. Although this does not imply that what is accepted is creative; this category is dialogical in that it keeps a discussion open, rather than closing the subject as would a 2U, which immediately implies the value judgement of "correctness" and therefore finality. Therefore, a teacher who wishes a subject or a question to be explored, rather than merely answered, may reinforce an answer with a 3U rather than a 2U. The 3U acceptance of the correct answer does not terminate the discussion or discourage other divergent answers; whereas a 2U would automatically give the value of "correct answer", and close the subject and all other ideas differing from that one would be much less likely to be expressed.

3B gives credit to the student whose idea or statement the teacher uses or builds upon, or expands. Though teachers often use their student's statements, they don't always give credit to that student before his peers. 3B furnishes a certain amount of prestiege to the student, which proved to be quite motivating, in the classes where it was used. In the instance 2X is often used in sequence with 3B as the teacher consults the originator of a particular contribution on questions concerning his topic.

3D allows the student to deviate from the planned classwork, or the work being done by the other students in order to pursue his own idea. This gives the student the opportunity for independent investigation right in the classroom; which may well develop into creative productivity.

3PN calls the peers attention to a student's idea. It is not meant to be praise, or imply a value judgement on the statement; nor does it elicit peer discussion. What it does effect however is that the students think critically about

the statement since the teacher has not committed herself, it is up to them to decide whether to consider or bypass that particular contribution. Since careful consideration of what others say is necessary to dialogue, and critical consideration of ideas and problems is necessary to creative thinking. 3PN is considered a valuable dialogue category.

3R accepts the student's contribution by repeating all or part of his statement. This category ranks with 3U and 3PN, in that it gives no evidence of approval or correctness; neither does it reject the idea or imply incorrectness. Yet, by repeating the student's statement the teacher has furnished some reinforcement. Again, the chief value is that of leaving the discussion open, (by refraining from judgement) while reinforcing the contribution.

3PD elicits peer discussion of a student's contribution. It is implied here that the contribution was worthwhile, controversial, or at least had the potential of stimulating a discussion that would be profitable. In all cases, eliciting discussion is eliciting dialogue with the potential of becoming creative interaction!

4OE is an open-ended question, where student's have a choice of answers. When used properly, this type of questioning elicits the opinions and critical thoughts and original ideas of the students; causes them to think things out for themselves, rather than to repeat memorized knowledge without understanding. As is pointed out in the discussion of creativity and questioning, the effectiveness of any type of question is dependent on its proper use, coupled with the types of answers that are reinforced or elicited; making these factors all interdependent.

4B building or leading questions though often used to elicit divergent thinking can just as easily be leading to a "dead end"; i.e. reaching for the one and only adequate answer, and therefore cannot be considered as a dialogue category.

6F directions require mental activity immediately, and overt activity later. This usually requires thoughtful consideration, and planning as well as retention of ideas, and implies a certain amount of integrity on the part of the students. Since one step in achieving a certain level of performance in students is to expect it; this category is instrumental in accomplishing the high level of performance necessary for creative productivity.

6OE directions give students a choice of action, while expecting immediate action. This type of direction expects that the student employ his own knowledge and initiative in carrying out the direction and invites innovation. This type of freedom within known boundaries of safety and deportment is only possible in a classroom where self discipline and integrity are established and, properly used. It is a good indicator of the presence of the dialogical atmosphere. A minimal amount of 6CE, closed-ended directions, is necessary at times to establish guidelines, and safety precautions that should be clearly and directly stated.

9E consists of voluntary encouragement, support, praise, or appreciation of a student's contribution by one of his peers, or occasionally several of his peers. It presupposes dialogue in that, in order to appreciate or support another's statement, one must have been listening with the intention of grasping the meaning of his peer's ideas (See description of dialogue Section II, p. 4).

9BC, critical discussion, correction or elaboration of a student's contribution, either by himself, or a peer presupposes the very attentive participation in classroom interaction that is attributed to dialogue: ideas are communicated, meanings are understood and corrected or accepted, from which new ideas and meanings are conceived and shared.

9V, voluntary participation in the activities connected with a peer's contribution is not only very reinforcing to the originator of the idea, but is likely to inspire others to offer equally innovative and valuable ideas as well as lead the volunteers into creative understanding and contributions of their own. This type of cooperative attitude, and the cooperative effort which is its outgrowth, are the fruits of dialogue.

9C, creative contributions of the students, are divided into two numerical designations to indicate the initial statement (95), and the sustained, uninterrupted continuation (97). A creative contribution is always vitally interesting to its originator, and probably will fascinate some of his peers as well. In a dialogical atmosphere where peers are attentive and the teacher is receptive, the occurrence of one creative idea can snowball into a discussion which considers, speculates, and elaborates on this idea with the potential that more creative contributions will occur. The extent to which a unique idea is pursued or allowed to continue also effects the occurrence of similar ideas, so that the numerical category representing sustained creative contribution (97) is also pertinent in predicting the continual occurrence

of creative contributions in the classroom.

Dialogue Categories and Predictor Categories.

As can be seen in Table 4, the dialogue categories are not the same as those categories that were found to be "predictor" categories in the study. This in no way lessens the validity of the dialogue categories as being important categories in the stimulation of creativity; since, as has already been pointed out, the meaning of the word "predictor" in this case is occurrence of the category within five steps previous to the category "predicted". This finding emphasized that, though numerical and statistical data are a necessary part of every research study, these data alone, can tell us little about a phenomenon so subjective as creative activity; but considered along with all of the other observations and data collected in the study, such mathematical data as "predictor" percents and dialogue percents illustrate previously known facts about the learning process and throw new light on the particular problem of the learning atmosphere that facilitates creativity.

Table IV: Predictor Categories and Dialogue Categories.

PC	1U		2PS	2PW	2X	2I	3U			3PN	3I		3PD	
DC	1U	2PA			2X	2I	3U	3B	3D	3PN	3I	3R	3PD	

PC	4W	4B	4OE	4RV		6OE	7ED	7CS	8A	9E	9BC		9C	10B
DC			4OE		6F	6OE				9E	9BC	9V	9C	

PC = predictor categories; DC = dialogue categories.

It seems hardly necessary to point out that mere physical proximity to the creative contribution does not automatically attribute an innate influential effect to any particular category. Some categories, although they actually at times effect a creative contribution, are just as appropriately used to effect other student responses. In choosing the dialogue categories, a subjective judgement had to be made whether the appropriate and proper use of the category was primarily to elicit or stimulate potentially creative interaction specifically, or whether its appearance in the interaction definitely indicated that dialogue was taking place.

Criterion Percent Categories.

Criterion Percent represents the part of the total frequency of one category that was preceded or lead into by a particular other category. These data were used to compare the dialogue categories to those most often concerned with (i.e. found within 5 steps preceding) the creative category to see if teachers were making best use of the dialogue categories. The comparison of Predictor Categories and Dialogue Categories in Table 4, indicates that the teachers in this sample did not make the best use of the dialogue categories; in fact, many of the dialogue categories do not even appear as "criterion" categories. Again, it must be pointed out that the mere physical proximity of one category to another is not conclusive evidence of their causal relationship, or lack of same. However, there is still further evidence that the dialogue categories were not utilized, and that is conclusive. (See Table 5, p. 55) Category 2PA was used only twice in just one of the classes. It could hardly, therefore, have been expected to show up percentage-wise as either a predictor or a criterion for creativity. Category 9V was never used in any of the classes. This evidence is given to explain that there is no statistical evidence to date that the dialogue categories and only those categories stimulate creativity, and that all others deter it. That is not at all what we have set out to prove. Rather we wish to elucidate techniques, interactions, and methods which effect creativity, both in a positive and a negative way, and point them out for those who would wish to increase creative productivity in their classes and students.

The Dialogue Percent and Frequency of Creative Contributions.

The Dialogue Percent, a figure derived by dividing the total frequencies of all of the dialouge categories (Table 5) by the total interaction frequency (tif), was found to coincide with the occurrence of creative contributions as a percent of the total interaction. Table 6 shows the dialogue percents for each class from the highest to the lowest; the total interaction frequency (tif); the frequency of the creative contribution initial statements (9Ci); the percent of creative contribution initial statements; and the number of dialogue categories utilized in each class. Two general trends are suggested by this table which illustrate that which was observed in the classroom. 1. Number of dialogue categories used: The first trend indicated by the data was that the more versatile the class was in the utilization of different categories, particularly the dialogue categories, rather than the majority of interactions being of the same category,

Table 5: Frequency of Dialogue Categories

Category	Class 1	2	3	4	5	6	7	8	9	10	11
1U	10	22	30	23	4	4	4	35	11	42	13
2PA	2	0	0	0	0	0	0	0	0	0	0
2X	71	40	59	35	10	15	2	29	16	11	7
2I	25	5	3	0	2	1	0	2	3	12	2
3U	63	66	68	43	34	21	3	10	5	16	21
3B	164	108	95	62	21	38	24	83	33	108	101
3D	3	16	17	13	0	0	0	1	1	0	0
3PN	16	10	7	8	0	2	7	16	0	10	6
3I	2	0	0	0	0	0	0	0	0	0	0
3R	134	137	92	93	9	1	2	11	2	8	1
3PD	11	14	7	20	11	56	11	73	73	61	76
4OE	47	117	112	77	33	19	8	31	34	32	2[illegible]
6F	23	20	5	0	0	0	0	2	0	3	0
6OE	9	17	13	38	10	2	0	32	17	18	8
9E	36	12	56	34	3	5	0	5	3	14	67
9BC	27	86	64	51	4	2	0	16	11	34	9
9V	0	0	0	0	0	0	0	0	0	0	0
$9C_i$	94	35	45	17	11	5	0	30	2	52	22
$9C_s$	156	65	48	27	12	21	0	53	1	79	70

For description of dialogue categories see p. 46.

the higher the dialogue percent and the greater was the percent of creative contributions. Total interaction frequency: In classes where the interaction was more rapid (illustrated by a higher tif), more creativity occurs.

There are some deviations from the perfect correlation of the data, which give us the opportunity to point out some of the observed conditions both favoring or hindering the process of dialogue in the classroom. The first trend is illustrated by comparing classes 2, 3 and 4 (Table 6) which have similar dialogue percents. In class 4 fewer dialogue categories were used and the percent of creativity was considerably less than in classes 2 and 3. The small number of dialogue categories used by the teacher in class 10 seems to contradict this; however, the figures here are deceiving, for this teacher made specific use of the 4B category to stimulate divergent and critical thinking. Also, the use of the 5 category in class 10 was unique, in that it was rarely used to provide pertinent factual information either in introductory or intervening teacher contributions. Rather this category usually consisted of motivating or provocative statements or tales of current events, or notices of coming events and suggestions as to sources of information outside the classroom: such as T.V. series, coming celestial events, past events, science clubs, goodies to be sent off for, periodicals that could be obtained, new acquisitions in the library, etc. This class was highly motivated and did a great deal of their work independently and outside of the classroom. Thus in class 10, categories 4B and 5 could be added to the number of categories used as dialogue categories.

In illustration of trend 2, it was observable that the type of interaction referred to as dialogue was more rapid than other types and resulted in a larger tif. Therefore, a larger tif corresponded to a greater creativity percent and vice versa, where the dialogue percent and the number of dialogue categories used were the same. Class 4 also illustrates this observation; and the two trends together explain the low creativity achievement in this class. While the number of dialogue categories was slightly lower, the percent of creative contributions was considerably lower in class 4 than in classes 2 and 3. This was due to the much lower tif in class 4 which indicated that not much of the rapid dialogue interaction was present. It was in fact, noted on the sequence of student speakers chart that, although the dialogue categories appeared, they were not used to advantage and often the interaction was extremely monological and strayed off

Table 6: Some Factors Influencing the Percent of Creative Contributions.

Class	Dialogue Percent	Number of DC Used	TIF	Percent Creative Contributions
1	34.63	18	2579	3.64
10	33.45	15	1495	3.61
3	29.78	16	2421	1.44
2	29.91	16	2581	1.43
8	21.25	16	1854	1.08
11	20.72	14	2066	1.06
4	28.88	14	1873	.91
5	10.75	13	1525	.73
6	15.96	14	1203	.41
9	13.39	14	1583	.13
7	3.60	8	1672	.00

DC = dialogue categories
TIF = total interaction frequency

the subject to the extent of being totally irrelevant and frivolous, at the expense of truly creative productivity.

Classes 4, 6, 7 & 9 all demonstrate that proper use of the dialogue categories is necessary. Class 4 (mentioned above), illustrates how children can run away with freedom unrestrained by discipline. (It should be recorded that this occurred at a most difficult period of the day, the one immediately following the lunch hour). Class 6 shows that even where a student-teacher rapport is good, failure on the part of the teacher to recognize the creative value of student contributions, and inability to use the dialouge categories provacatively, can cancel the effects of the reassurance and good will that opened the channels of dialogue. Class 9 shows how talking "down" to a class can stifle the creative production of the student. Spoon feeding, or babying students is not conducive to the type of self-motivated critical thinking that is typical of creativity; and even though the kindness of the teacher paid off in student cooperation and attention, the obvious ineptness at handling any kind of deviate responses or questions served to stifle the creative efforts of the students. Class 7 is the classic example of the lack of versatility and its annihilation of creativity. Not only did the interaction in this class consist mainly of 5's and 8's but the teacher also failed to detect the value of those few dialogical categories when they did occur in the interaction.

Class 5 on the other hand, while it ranked with 6 and 9 in the number of dialogue categories used and the amount of total interaction, still exceeded them in creativity percent. In this case the students were from homes where both parents worked: television was their principle diversion, and no time was devoted to the pleasure of independent reading. While educational T.V. has made great strides, there is nothing discovered yet to take the place of reading, in order to raise the reading level and reading comprehension of students. A low average reading level was the problem with which this teacher was faced, and much of the class time was spent in reading aloud (greatly reducing the total interaction frequency). In spite of this, the teacher managed to induce understanding and realization of problems, and to stimulate thought and curiosity which demonstrated itself in the form of brief dialogical periods at various times during the sessions. If only the true interaction in this class had been recorded, and not the reading aloud sessions, it would have ranked much higher, but this would not have given us

the opportunity to demonstrate, with our data, the importance of reading skills and reading comprehension throughout the disciplines; and to show how a low reading level inevitably impedes the natural creative tendencies in the 5th grade students. in classes dependent upon reading skills.

Thus we see that the three factors in Table 6 combine to indicate, albeit imperfectly, the creative atmosphere, that is, the amount of dialogue and independent thought and activity present in the classroom. The first factor, the dialogue percent, shows the percent of time spent in using dialogue categories; although it does not necessarily prove the amount of time spent in dialogue, as will be seen below. The second factor, the number of dialogue categories used, hints at whether the dialogue categories are being used appropriately in the following manner. Since by definition, all of the dialogue categories are either necessary to or indicative of dialogue, ideally most should be present. The absence of several dialogue categories was most frequently found to be concurrent with the absence of true dialogue (as shown in the observer's notes on classroom conditions) indicating the misuse of those dialogue categories present. Furthermore, it was usually true that the more dialogue categories used, the more secure was the atmosphere of dialogue. The third factor, the total interaction frequency (TIF) in a given time period, indicates the vigor of the interaction. Since it was found that enthusiastic dialogical, creative interacation always resulted in a higher TIF than the average twenty-tallies-per-minute, this is also an indication of the presence of true dialogue. That is to say, a high dialogue percent of a high number of dialogue categories used, accompanied by a low TIF (one close to or lower than 20-tallies-per-minute) would indicate that the dialogue categories were misused and that dialogue probably did not occur.

SECTION VI: CONCLUSIONS AND RECOMMENDATIONS

It was our desire to explore the quality of tenuous fragility and destructability of human creativity, and to present some helpful guidelines which would aid teachers in their relentless efforts to bring out the potential in their students. Although we furnish little statistical proof for our observations, we offer what we feel is even better, the opportunity for each reader to consider with us the evidence which prompted our conclusions and from this evidence to draw his own conclusions, thereby extending this study in his personal experience. We are pleased at the headway we have made toward accomplishing our desires and reasons (See objectives p. 6-7) for undertaking this study.

Objective 1: To bring teachers to think of their pupils as having more or less creative ability rather than as having creative ability or not having creative ability.

It is the opinion of the author that this teacher attitude is necessary in order that the teacher, ever aware of the possible creative potential of every child, will be on the look out at all times and in all circumstances for the "symptoms" of creativity in his students. This openness to the possibility of creative potential is necessary to put the teacher in the frame of mind to accept our other findings and suggestions, at least long enough to test them in his own classroom and himself employ the techniques and methods we observed to be favorable to the creative process. It was to this end (objective 1) that the introductory section of the study was painstakingly written to thoroughly explain our position and philosophy and to convince those who will to join with us even to the point of documenting their separate findings.

Objective 2: To demonstrate that creativity is not confined to the exceptionally gifted child.

None of the classes chosen to partake in the study were considered by their grouping, their administrators or their teachers to be exceptionally gifted. Yet creativity indicators were isolated and verified in all classes but one; and even in that one, indicators were observed and pinpointed, but could not be verified under the standards set for the study. The number of students who contributed creative interactions in each class corresponded to the opportunity to express their own ideas in class more than to any other single factor. In Class 1, 26 out of 30 students contributed creatively to the verbal interaction. Table 7 shows the number of students involved in the creative interaction of each class.

Table 7: Students involved in Creative Interactions (C.I.= Creatively Involved)

Class	1	2	3	4	5	6	7	8	9	10	11
C.I. Students	26	9	9	8	8	1	0	13	2	19	13
Total Students	30	21	20	20	28	30	30	29	29	32	34
Percent	86 $\frac{2}{3}$	42 $\frac{6}{7}$	45	40	28 $\frac{4}{7}$	3 $\frac{1}{3}$	0	45	7	60	38

Although the scope of this study did not allow such a diversion from the main objectives, it would be an interesting study in itself to compare such factors as individual backgrounds, grade point averages and IQ's of the students who contributed creatively in each to those of students who did not. The subjective judgement of the observer-recorder notes, that it was not always the best informed nor the most verbose student who responded with the greatest amount of originality. It was further observed that some students who contributed little to the interaction at first, gained understanding later and were able not only to take part, but to formulate their own creative explanations, theories or questions (observed particularly in Classes 5 and 8).

Objective 3. To develop simple cirteria by which creativity in the individual may be easily identified in the classroom.

The six Criteria for Identifying Creativity Indicators in Classroom Interaction are thoroughly described and explained in Section III pp. 8-10) and Appendix A pp. 68-69.

Objective 4: To demonstrate that creativity can be stifled and retarded in the classroom.

The classic example of the stifling of the creative curiosity of children appeared in Class 7 (See also p. 40). However, it was also very enlightening to note that in other classes, class 1 for instance, where the percent of creative interactions was high, those ideas, considered by the observer to have potential, that were overlooked or in some way discouraged by the teacher were discarded by the students. Following are a list of situations that effectively stifled creativity.

1. Short class period. Too short a class period, particularly where every moment is taken up with "busy

work" and then there is no time for discussion, inquiry and closure. It was noted that 20 minutes was not sufficient. Something would surely be neglected and usually it was the activities in the higher cognitive and creative levels that were left out.

2. Too strict adherence to lesson plan. Although it is excellent policy to plan ample material to more than fill the class time, and even to rehearse interaction and lectures, and anticipate answers and lead-ins, the very uniqueness which is a part of the definition of creativity, forewarns the teacher that many of the potentially creative ideas will deviate from her plans and expectations. We underline this fact in hopes that forewarned is forearmed.
3. Failure to take advantage of student questions. Any student-originated question has more motivating potential than a teacher instigated question. No matter how thought-provoking the teacher thinks his questions are, he should always take time to judge whether he could possibly use a student's idea to lead up to his desired ends. It often takes a slightly longer time, with some detours along the way, but those very detours may prove to be actual sitmuli for the desired responses.
4. Teacher-Objectives too limited or narrow. Whether due to an inadequate subject matter background, lack of imagination or what have you, some teachers are blind to the value of behaviors, answers or ends that occur spontaneously, even though they are equal in significance to his own. This is not to say that one must not have specific and succinct objectives. On the contrary, the more completely defined are the objectives, the more likely they are to include diverse individual and unique responses which are appropriate or pertinent to the topic.
5. Slow start. Nothing looses the classes' interest more quickly than a lengthy prelude to which the students have had no interest-arousing motivation. This includes also, spoon feeding and babying a class, which bores the students and insults their intelligence.
6. Abrupt start. It can occur when trying to be innovative, that a teacher leaves too much to the imagination or fails to furnish the necessary lead-in which causes an otherwise dynamic idea to fall short of its goal. A happy medium between number 5 and number 6 is the best solution. One teacher in our sample provides the tie-in by letting his students tell what they know about a new topic (See pp. 35-36); from there he can build his lesson geared to their backgrounds, omitting repetition and elaboration of known facts while leaving clues to discovery of new challenges and guiding the students to satisfactory solutions and answers.

7. Lack of respect and discipline. This is perhaps the greatest menace to dialogue and creativity. No student wishes to be ridiculed and therefore will not risk the dialogical word (honest, unique, sincere, original ideas) in an undisciplined atmosphere. Little progress of any kind can be made toward creative or any other type of learning until mutual respect and discipline have been established. (See pp. 42-44)
8. Immediate, direct answers to student questions. This has the unfortunate effect of prematurely terminating a subject. When possible, teachers should take time to explore the interest indicated by a student's related question before answering it and closing the subject. If it is found to be completely personal, take it up with the student on a one-to-one basis when the rest of the class is occupied, if not, use it to open a profitable discussion.
9. Exclusion of open-ended questions (4OE's) and student originated contributions (9's). This needs no explanation. It is done by favoring (by reinforcement) category 8 as a student response and failure to accept or reinforce responses of the type that the 9 categories describe. By the very category descriptions, dialogue and creativity are dependent on the presence of the 9 categories and the corresponding categories which elicit, accept and reinforce them.

Objective 5: To demonstrate that creativity can be induced and developed in a proper classroom atmosphere.

Section IV is devoted to the discussion of the various factors which induce and develop creativity by creating or sustaining a dialogical atmosphere which was found to be the atmosphere in which verbal creative contributions occur.

Objective 6: To demonstrate that certain teacher techniques and peer interactions do affect creative expression.

During the course of the study we have observed the techniques, categories and methods used by the participating teachers to elicit creative interaction in the classroom. These positive (as we will call them) techniques or categories or methods were found to be completely lacking in the classes or instances where creativity did not occur; or when they were apparently present were so misused as to render them ineffectual and, in essence, absent.

Conversely (in support of objective 4) factors which did not result in creativity or actually seemed to prevent its occurrence (we'll call them negative factors) did so, not only in the low creativity classes but were also found to

stifle it in specific instances in which they occurred even in the highest creativity classes - emphasizing their role as creativity inhibitors.

No factors specifically were proven to have been creativity stimulators, however, we can name general techniques which, making use of the categories listed as Dialogue categories (listed on page 46) and some (See Table 4, p. 53) categories to effect the type of atmosphere that was most productive of creative contributions. These techniques are discussed in a previous section and are merely listed here in summary, as general factors effecting creativity in the classroom.

1. The percent of dialgoue categories used by teachers, though different combinations were employed by different individual teachers.

2. The type of questioning employed by the teacher and his skill in using provocative questioning (questioning categories discussed individually on p. 35 and following).

3. Deliberate reinforcement of contributions which are on a higher congitive level, (i.e. show some manipulation of facts) as well as of pertinent original and creative contributions. (See p. 38 and following)

4. Type and effectiveness of class discipline. (P. 42 and following)

5. Type and amount of teacher preparation. Sometimes the effect of teacher preparation is obscured by the teacher personality and native ability in stimulating response from students, (discussion of teacher preparation p. 44 and following).

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Appendix A.--Criteria for Identifying Creativity Indicators in Classroom Interaction

1. The expression by a student, of an idea which the teacher did not present.

   a. Student suggests an original approach to a problem which has been brought up in class.
   b. Student poses a question or suggests a mode of action which, when answered or when done, may shed light on the causal explanation of an observed phenomenon.
   c. Student states a fact or belief, in his own words, which shows by the way it is stated that he has some insight about it; in contrast to merely repeating a meaningless (to him) fact or memorized definition.
   d. Lab Situation: Student calls attention to his own work, believing he has arrived at a known objective by his own means, which means he deviated from the prescribed procedure, or else there was no prescribed procedure in the first place. By prescribed procedure, is meant Lab Manual, or teachers instructions or suggestions made available to the student.

2. Expressed preoccupation with an idea or problem, or strong motivation to solve a problem.
   a. Idea: Student persists in defending the worthwhileness or validity of his idea, theory or hypothesis, by:
      1) Verbally defending proposition with logical explanation of idea.
      2) Devising an experiment to prove or disprove the idea.
      3) Volunteering to seek corraborative information from sources outside the classroom.
   b. Problem:
      1) Student persists in his verbal desire to pursue the problem to a logical explanation and clarification, rather than being satisfied with a mere statement of fact, or demanding a mere statement of correct answer.
      2) Student expresses desire to explore a project beyond the current knowledge of the classroom.
         (a) Student suggests a problem he would like to pursue giving an idea of how he intends to develop it on his own, and/or what aspects of the problem he intends to attack; or otherwise indicating real interest and some insight, rather than just parroting something he read, saw or heard.
         (b) Student volunteers to investigate an aspect of class discussion which interests him, and

which for one reason or another is beyond the realm of the class investigation.

3. The amplification, by a student, of an idea already expressed either by another student or by the teacher. This is achieved by:
   a. More precise definition: clarification indicating greater insight into the problem, or distinction between the variables involved.
   b. Extension: introducing something new about the problem or topic that is pertinent, possibly useful, or interesting. Again, it must indicate some insight into the subject.
   c. Different approach to the problem: involving restatement, reorganization, or even reformulation. Differentiated from 1. a. in that the approach is not original with the student, but merely improved by new insight, restatement, etc.
   d. Simplification: student devising, method of arriving at desired objectives or solutions which requires less effort than the method thus far made available to him or the group, but still effecting the desired outcome.

4. Questioning by student, concerning the subject which demonstrates a curiosity leading to the investigation of that subject in contrast to questions which would require the definite immediate solution furnished by the teacher (i.e. the right answer).

5. The expression of an idea which relates classroom discussion to unmentioned or unsolved problems, or vice versa. Student attempts to apply ideas which have been or are being discussed in order to pursue unsolved problems in the same or in another unit or discipline.

6. Penetrating questioning: Student or students ask logically progressive questions which will supply the logical structure not previously obvious.

Appendix B.--Original Plan for the Modification of the Flanders Interaction Analysis

Flanders interaction analysis is a system of classifying verbal interaction in the classroom. The system consists of seven categories for teacher talk, two for student talk and the tenth category for silence, or no talk (see scale, Figure 1.) The system has been modified to accommodate types of teacher questions (category 4) and types of peer interaction (category 9).

The categories will be expanded as follows:

Category four will be used as a mere "4" in calculating the ID ratio (See Figure 2.). For the analysis before and after a creative act it will be divided into four sub-categories.

4a. Question leading to fact, fact recall answer, such as: remembering, recalling, classifying, duplicating, repeating, recognizing, or identifying.

4b. Questions requiring the student to manipulate the data in some way, rather than just to remember it, (by comparing, relating, discriminating, reformulating, illustrating).

4c. Questions requiring the student to manipulate the data and then to go beyond the data, or add to it, by: explaining, justifying, predicting, eliminating, interpreting, making critical judgments, or drawing inferences.

4d. Questions which expect the student to do all the above, plus provide his own data, that is by: creating, discovering, reorganizing, formulating new hypotheses, new questions and problems.

In the breakdown of category four we have made use of ideas from the "Levels of Performance" described by James M. Bradfield and N. Stewart Moredock.

Category nine of the Flanders scale will be expanded into two categories depending upon their possible effects on a student who has previously expressed, or attempted a creative act. There will be three divisions of category nine.

9a. Statements which are neutral, that is do not refer to another student's statement at all. These statements will often be direct answers to a direct question by a teacher. In such a case they will be categorized a "8's".

FIGURE 1.--SUMMARY OF CATEGORIES FOR INTERACTION ANALYSIS

TEACHER TALK	INDIRECT INFLUENCE	1. *ACCEPTS FEELING: accepts and clarifies the feeling tone of the students in a nonthreatening manner. Feelings may be positive or negative. Predicting or recalling feelings is included.
		2. *PRAISES OR ENCOURAGES: praises or encourages student action or behavior. Jokes that release tension, but not at the expense of another individual; nodding head, or saying "um hm?" or "go on" are included.
		3. *ACCEPTS OR USES IDEAS OF STUDENTS: clarifying, building, or developing ideas suggested by a student. As teacher brings more of his own ideas into play, shift to Category 5.
		4. *ASKS QUESTIONS: asking a question about content or procedure with the intent that a student answer.
	DIRECT INFLUENCE	5. *LECTURING: giving facts or opinions about content or procedures; expressing his own ideas, asking rhetorical questions.
		6. *GIVING DIRECTIONS: directions, commands, or orders with which a student is expected to comply.
		7. *CRITICISING OR JUSTIFYING AUTHORITY: statements intended to change student behavior from non-acceptable to acceptable pattern; bawling someone out; stating why the teacher is doing what he is doing; extreme self-reference.
STUDENT TALK		8. *STUDENT TALK - RESPONSE: talk by students in response to teacher. Teacher initiates the contact or solicits student statement.
		9. *STUDENT TALK - INITIATION: talk by students, which they initiate. If "calling on" student is only to indicate who may talk next, observer must decide whether student wanted to talk. If he did, use this category.
		10. *SILENCE OR CONFUSION: pauses, short periods of silence, and periods of confusion in which communication cannot be understood by the observer.

*There is NO scale implied by these numbers. Each number is classificatory; it designates a particular kind of communication event. To write these numbers down during observation is to enumerate--not to judge a position on a scale.

9b. Statements which are encouraging to another student, such as supportive, reinforcing, cooperative, additive, approving, or admiring statements.

9c. Statements which might discourage another student, but these would include conflicting ideas, ridicule, competitive statements, criticism.

NOTE: Criticism by the teacher would be included in category seven.

Teacher-pupil interaction will be recorded by the observer, listening to the tapes: A mark corresponding to the category number will be recorded every three seconds. If the interaction category changes within the three-second interval, it will be marked immediately and the three-second interval continued when possible. Approximately twenty marks are made per minute. The numbers are then transferred to a matrix (See Figure 2).

FIGURE 2.--Interaction Matrix

	Second Action									
	1	2	3	4	5	6	7	8	9	10
1	1				1				1	
2		4	1					2		
3		1	6	1				2		
4			1	14				5		
5	1				48			6		
6						1		4		
7							4		1	
8		2	2	5	6	4		11		
9	1						1		9	1
10									1	2
Total	3	7	10	20	55	5	5	30	12	3
Column %	2	4½	6½	13½	36½	3½	3½	20	8	2

Matrix Total: 150

Teacher Talk

Columns 1-7 = 105

105 ÷ 150 = 70%

Student Talk

Columns 8-9 = 42

42 ÷ 150 = 28%

Indirect (1-4) ÷ Direct (1-4) plus (5-7) = I/D Ratio

$$\frac{40}{40 \text{ plus } 65} = \frac{40}{105} = .38$$

Indirect (1-3) ÷ Direct (1-3) plus (6-7) = Revised I/D Ratio

$$\frac{20}{20 \text{ plus } 10} = \frac{20}{30} = .67$$

Appendix C.--Brief Summary of Verbal Interaction Categories Oriented Toward Creativity.

TEACHER TALK

10-1U Accepts Feelings: of the student
20-2U Encouragement of Praise: unclassified
21-2PA Peer Action: encourages peers to participate in student's idea
22-2PS Praises Student
23-2PW Praises Work: or oral contribution
24-2X Explanation: requests or encourages amplification, explanation
25-2I Investigation: encourages student to pursue or explore his idea
30-3U Accepts Ideas: unclassified
31-3B Builds: expand, builds on, uses student's statement
32-3D Deviation: allows student to deviate from class work, pursue idea
33-3PN Peers Note: calls peer attention to student's statement
34-3I Inform: offers to better inform herself on student's subject
35-3R Repeats: repeats student's statement
36-3PD Peer Discussion: elicits peers to discuss student's contribution
40-4W What Questions: requests repeat when student was not heard
41-4B Building Questions: asks building or leading questions
42-4OE Open Ended Questions: questions requiring no predetermined right answer
43-4CE Closed Ended Questions: right answer is expected
44-4RV Recognizes Volunteer: allowing him to speak
50-5U Lecture: gives information and opinions; rhetorical questions
61-6F Futuristic Directions: where overt behavior isn't expected till later
62-6OE Open Ended Directions: choice of action allowed
63-6CE Closed Ended Directions: to be followed explicitly
71-7ED Evidence of Disapproval: expects and effects change of behavior without severity
72-7I Ignores: or deliberately interrupts student statement
73-7CS Changes Subject: from student's idea or thought
74-7PC Peer Criticism: invites or encourages peers to criticise student
75-7S Scolds: or otherwise strongly indicates disapproval
76-7Q Questions: questions which make student realize his error (deportment)

STUDENT TALK

80-8U Unclassified Response: answers are specific, as differentiated from self-initiated ideas.
81-8A Acknowledgement: response to 3P, often collective
90-9U Self-initiated Unclassified
91-9E Encourages: voluntarily encourages or praises fellow student
92-9BC Being Critical: of own or peers contributions
93-9D Discourages: can be voluntary or response to teacher's 7PC
94-9V Volunteers: take active part in another student's contribution
95-9C Creative Contribution: see 6 criteria for deciding this category (Appendix A, pp. 67-68).
98-9PC Peer Conducted: Student conducting class calls on peer
01-10P Productive: silence or multiple conversations
02-10N Neutral: silence or inaudible-technical or reception difficulties
03-10P Non-Productive: silence noise or confusion
04-10B Break: between two conversing students

Appendix D.--Description of Schools and Classes.

School 1

Member Houston Independent School District, located in a area containing upper-middle to middle-upper class people economically and culturally. Class 01 from School 1 had science taught as a separate subject, 3 times a week, in a self-contained classroom, not by a special science teacher.

School 2

Private School, located in a suburban area of upper class homes. Generally students were from culturally and economically rich families. Parents hold higher degrees, professional people. Classes 02, 03, and 04 had science taught as a separate subject daily in the classroom of the science teacher. Class 02 was taught other subjects by the science teacher's as well. Class 03 and 04 came to science teacher's room while her class (Class 02) attended music and language classes.

School 3

Member of the Houston Independent School District, located in upper-lower to lower-middle class area. Several black teachers and students. Learning (especially reading) disabilities and emotional and nutritional problems evident. Classes 05, 06, 07 from School 3 had science as a separate subject in a self-contained classroom twice a week; not by a separate science teacher.

School 4

Member of Houston Independent School District located in an area of upper-middle class people. Few students had an I.Q. less than 100. Majority of parents have College Education. Very old, stable neighborhood, very mixed economically. Classes 08 and 09 from School 4 had science taught as a separate subject twice a week in a self-contained classroom - not by a separate science teacher.

School 5

Member of Houston Independent School District, located in a lower-middle class area. One tenth (1/10) of the students have academic and emotional problems - demonstrated as difficulty in auditory and visual descriminations. Majority of parents having no college. Higher on economic scale than on cultural scale except for 5% prominant Cuban families. Families are TV watchers and children not accustomed to forming or having opinions. Classes 10 and 11 from School 5 had science taught as a separate subject, daily, in a self-contained classroom, not by a special science teacher.

Appendix E.--Miscellaneous Research Forms

Form 1: Form letter to principals.

Form 2: Research Participation form for teachers.

USOE Project #9-G-043 University of Houston

FORM LETTER TO PRINCIPALS

Dear (Principals' names were inserted here)

The Science Education Department of the University of Houston will be conducting an investigation of the very evasive subject of creativity, beginning in September 1968. To date, creative ability has not been studied in the classroom without the extensive use of burdensome testing. In recent literature on the subject, writers have expressed the need for non-test methods of identifying creativity in the classroom. The purpose of our research is to test verbal criteria for the recognition of creativity, and to study the techniques used by experienced teachers to stimulate student interest and productivity.

To achieve our purpose, we must depend on the help and cooperation of interested teachers as our sources of data collection. We have designed our study to involve minmum effort or change of pace on the part of the teacher, and minimum disruption of the class.

Our procedure requires that we secure permission to enter and tape record four consecutive science sessions on the fifth grade level, for each class participating in the study. The observer will be present at all times during the recording period, leaving the teacher completely free to carry on the class session as usual. All school, teacher and student names will be coded and all information will be considered as confidential. The remainder of the study will be conducted through the examination of the tape recordings, with no further encroachment on the teacher and class.

We will be happy to furnish you with a summary of our findings at no expense to you.

Please indicate your consent to our conducting this study in your school by so stating on this page.

Thank you for your indulgence. We look forward to working with you and your teachers this fall.

Respectfully,

Stephanie J. Kubicek
Principal Investigator

Silas W. Schirner, Director
Science Education
University of Houston
Houston, Texas

____ We will cooperate with you in the study.

____ We are undecided at present but will discuss the possibility of cooperating with you by appointment.

____ We will not cooperate with you in the study.

_____
(Signed)

USOE Project #9-G-043 University of Houston

RESEARCH PARTICIPATION FORM

Mr.
Mrs.
Miss_____ _____
TEACHER'S NAME Home phone (Optional)

_____ _____
School Address School phone

Time available for phone call: (free period, lunch, other)

_____

Is your science period in a self-contained classroom?
yes_____ no_____.

Is science taught as a separate subject? yes_____ no_____.

Do you have science scheduled for a particular time?
yes_____ no_____.

Length of period_____Time of day_____

If not daily, specify what days_____

You will be recorded during 4 consecutive science periods per week, regardless of how they are scheduled. A period is considered to be approximately 30 minutes; they may be longer; if you wish to extend periods to one hour as for field trips or lab excursions, this is entirely up to the teacher, no changes in plans or lesson schedules need be made. The only requirement is that the four periods (per class) be consecutive, that is that no science lessons intervene between recording sessions, no matter how many days may intervene between science lessons.

The date to begin recording will be, as nearly as possible, up to the teacher.

Date you think you would like to begin recording:_____

No preference as to date_____

We hope to have all recordings completed by the end of the semester. Feel free to call about any and all particulars.

Mrs. Stephanie J. Kubicek, Principal Investigator

University of Houston, Department of Curriculum and Instruction
Rm. 211 W-2 Bldg. Phone: 748-6600 x 1764
Office hours 10-12 Monday, Wednesday, Friday or call and leave message.

Appendix F.--Forms Used in Tape Analysis

Form 1: Creative Verification Sheet

Form 2: Interaction Analysis Coding Form

Form 3: Sequence of Student Speakers Seating Chart

Appendix F.--Forms Used in Tape Analysis.

USOE #9-G-043 University of Houston

Creativity Verification Form

Tally#	Name	Contribution and Follow-Up
46	Mary Doe	Interested in starfish - IV3:48-69, 71-2 *75, *78, and all action thru 152
86	John Doe	if you cut starfish in 4 pieces will it make 4 starfish?
96	Ed Sled	interprets to mean halves - could possibly half it again
105	Jane Plain	compares it to that of eels tail
116	Sunny Day	if cutting it yields another, how kill it?
120	Charlie Sample	maybe it's like teeth-can do it once and no more
190	John Smith	if salt gets into O. by rivers, how get into R.?-IV3:*192, and can't taste it in fresh water
206	Paul Jones	river get salts from land minerals
224	Jim Slim	O. also get salt from rocks and plants
228	John Doe	O. get salt from rocks on shores
232	Joe Jones	You can't taste it in R. cause there's not enough in R. IV3:235 teacher builds on +John +Joel + teacher
364	Sunny Day	ear - helps it locate food begins much interaction
311	Jim Slim	animone 315-321 tells how meet and mate
402	Suzzie Que	how much and what baby whales eat and weigh IV3:403, 407-17
424	Sunny Smile	do shrimp have blood? IV3:428-30 Sunny + Ed Sled question and reason - look up

(Note: Actual data with fictitious names substituted for real ones)

USOE #9-G-043 Interaction Analysis Coding Form
University of Houston

School___Teacher___Class___Session___Tape Setting_____

Remarks: _____

_____

_____

1_____	41_____	81_____	121_____
2_____	42_____	82_____	122_____
3_____	43_____	83_____	123_____
4_____	44_____	84_____	124_____
5_____	45_____	85_____	125_____
6_____	46_____	86_____	126_____
7_____	47_____	87_____	127_____
8_____	48_____	88_____	128_____
9_____	49_____	89_____	129_____
10_____	50_____	90_____	130_____
11_____	51_____	91_____	131_____
12_____	52_____	92_____	132_____
13_____	53_____	93_____	133_____
14_____	54_____	94_____	134_____
15_____	55_____	95_____	135_____
16_____	56_____	96_____	136_____
17_____	57_____	97_____	137_____
18_____	58_____	98_____	138_____
19_____	59_____	99_____	139_____
20_____	60_____	100_____	140_____
21_____	61_____	101_____	141_____
22_____	62_____	102_____	142_____
23_____	63_____	103_____	143_____
24_____	64_____	104_____	144_____
25_____	65_____	105_____	145_____
26_____	66_____	106_____	146_____
27_____	67_____	107_____	147_____
28_____	68_____	108_____	148_____
29_____	69_____	109_____	149_____
30_____	70_____	110_____	150_____
31_____	71_____	111_____	151_____
32_____	72_____	112_____	152_____
33_____	73_____	113_____	153_____
34_____	74_____	114_____	154_____
35_____	75_____	115_____	155_____
36_____	76_____	116_____	156_____
37_____	77_____	117_____	157_____
38_____	78_____	118_____	158_____
39_____	79_____	119_____	159_____
40_____	80_____	120_____	160_____

(Note: Numbers continued on consecutive pages up to 600 tallies for each form. Additional pages were added for sessions which exceeded 600 tallies.)

USOE #9-G-043 SEQUENCE OF STUDENT SPEAKERS SEATING CHART University of Houston

School____Teacher____Class____ Remarks: Written assignment after discussion: write down what they said they wanted to learn about [topic].

Session___Date & Time_____

Name 001	Name 006	Name 011	Name 016	Name 021	
	40* suggests go to newspaper		color 16, 29, 46, 56	34	Teacher's Desk

Name 002	Name 007	Name 012	Name 017	Name 022	Name 026	
23	36, 46	octopus 17, 24	19, 54	49, 273	27, 28	Work desk and demonstrations

Name 003	Name 008	Name 013	Name 018	Name 023	Name 027	
43	38	18, 35, 41, 53	33			

Name 004	Name 009	Name 014	Name 019	Name 024	Name 028	
31	~~25~~, ~~47~~	~~20~~, ~~31~~ 25, 47	20, 32	26	30 --- shells 51	

Name 005	Name 010	Name 015	Name 020	Name 025	Name 029	Name 030
	26, 44, 45, 55	21	22, 52	48 -- 271 clam	37, 39-long one, 50 jelly fish colonies	63 earthquakes under water, 229, 236

Appendix G.--Use of the Fortran Coding Form

The data from the completed Interaction Analysis Coding Form must be translated into numerical codes and transferred to the Fortran Coding Form.

Translation of Interaction Analysis Data:
Each interaction was expressed as a five digit number on the Fortran Coding Form. The first two digits represented the responder: using student identification numbers to

---

Figure 1: Numerical Symbols for Response Categories.

(To be entered in columns 11-12, 16-17, 21-22, 26-27,... 76-77. of the Fortran Coding Form.)

1U = 10	3D = 32	4RV = 44	7S = 75	9D = 93
2U = 20	3PN = 33	5U = 50	7Q = 76	9V = 94
2PA = 21	3I = 34	6F = 61	*8U = 80	*9C = 95
2PS = 22	3R = 35	6OE = 62	**8U = 86	**9C = 97
2PW = 23	3PD = 36	6CE = 63	8A = 81	9PC = 98
2X = 24	4W = 40	7ED = 71	*9U = 90	10P = 01
2I = 25	4B = 41	7I = 72	**9U = 96	10N = 02
3U = 30	4OE = 42	7CS = 73	9E = 91	10NP= 03
3B = 31	4CE = 43	7PC = 74	9BC = 92	10B = 04

*Initial action.
**Sustained action of same category.

---

represent individual students, and other codes to represent group responses, teacher responses or unknown responder (See Figure 2).

Figure 2: Numerical Symbols Identifying the Responder.

(To be entered in columns 13-15, 18-20, 23-25,...78-80, on the Fortran Coding Form.)

001 - 281 = Individual identified responder indicated by the student identification number.
999 = Unidentified responder, or unison response by all or part of the class.
= Teacher response, to the student inferred by the category (that is, some teacher statements ordinarily preceed a student's statement, such as a question; while others follow a student's statement, such as certain reinforcement categories those that are not inferred must be further clarified.)

777 = Teacher response which acts on a student whose interaction does not appear within the five preceding or the five following actions.

888 = Teacher response which preceds the student whose contribution it acts upon, where it is usually understood to follow a student's action.

Transfer of Interaction Analysis Data to the Fortran Coding Form:

The procedure for entering the data on the Fortran Coding Form is as follows:

Column 1: School identification number: the schools were numbered 1 through 5.

Columns 2-3: Teacher identification number: the teachers were numbered 01 through 09.

Columns 4-5: Class identification number: the classes were numbered 01 through 11.

Columns 6-8: Computer card number: the computer cards were numbered 001 through 300, as necessary for each class. With each new class, the series of computer card numbers was begun again with 001.

Columns 9-10: Leave blank.

Columns 11-80: Interaction Analysis data: response and responder (See Translation of Interaction Analysis Data, and Figures 1 and 2).